

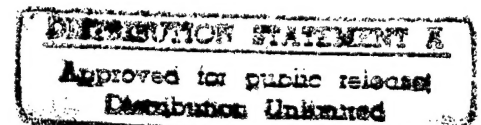
**REPORT OF THE
DEFENSE SCIENCE BOARD
TASK FORCE**



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**MILITARY PERSONNEL
INFORMATION MANAGEMENT**

AUGUST 31, 1996



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This report is a product of the Defense Science Board (DSB). The DSB is a Federal Advisory Committee established to provide independent advice to the Secretary of Defense. Statements, opinions, conclusions and recommendations in this report do not necessarily represent the official position of the Department of Defense.

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DEFENSE SCIENCE
BOARD

OFFICE OF THE SECRETARY OF DEFENSE
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October 17, 1996

MEMORANDUM FOR UNDER SECRETARY OF DEFENSE (ACQUISITION AND
TECHNOLOGY)

SUBJECT: Report of the Defense Science Board (DSB) Task Force on Military
Personnel Information Management

I am pleased to forward the final report of the DSB Task Force on Military Personnel Information Management, which was chaired by Dr. Alan Salisbury. The Task Force members and advisors unanimously concluded that the Department should develop and implement a single, fully integrated military personnel and pay system to be used by all components. The report further provides supporting recommendations on functional and technical criteria for the objective system; a transition strategy; and a management structure. It also recommends assignment of responsibilities for implementation.

In brief, the Task Force recommends:

- a single all-service and all-component, fully integrated personnel and pay system, with common core software built on a COTS base (or a modified-COTS system), with an Initial Operating Capability of 2001 or earlier;
- an acceleration of the process initiated by the Personnel and Readiness Military Personnel Management Joint Working Group to define joint functional requirements, with full participation from the Services, the Joint Staff, the Defense Finance and Accounting Service (for pay integration) and OSD;
- the purchase, by the Services, of COE-compliant platform-independent components in planned equipment modernization efforts not only to support the objective system but to meet technical guidelines and to achieve the benefits of high performance; and
- the identification of investment funds to design and develop software for the objective system beginning in FY 97.

The report and its recommendations have broad support from the OSD staff and the Service personnel chiefs. I recommend that the report be forwarded to the Secretary of Defense with a strong recommendation for implementation.

Craig I. Fields
Chairman



MEMORANDUM FOR CHAIRMAN, DEFENSE SCIENCE BOARD

SUBJECT: Report of the Defense Science Board (DSB) Task Force on Military Personnel Information Management

The final report of the Task Force on Military Personnel Information Management is attached. The Task Force members and the Advisors have unanimously concluded that the present situation, in which the Services develop and maintain multiple Service-unique military personnel and pay systems, has led to significant functional shortcomings (particularly in the Joint arena) and excessive costs for system development and maintenance for the Department of Defense. Moreover, it is clear to the members that there are no technical, functional or programmatic barriers which preclude the realization of a common system that can support all Services and all components. The report, therefore, recommends a single, fully integrated personnel and pay system to be used by all components. The report further includes supporting recommendations on functional and technical criteria for the objective system; a transition strategy; and a management structure. It also recommends assignment of responsibilities for implementation.

The most challenging area we addressed was the proposed management structure. The report reflects the clear consensus of the Task Force as to the management structure most likely to ensure successful execution of the program, while balancing the need for clear lines of authority on the one hand, with the need to ensure that the system meets the needs of the individual Services on the other.

It has been my privilege and pleasure to lead this Task Force. I would like to express my deep appreciation to the Task Force members for their generous participation and invaluable contributions. Their individual and collective experience, knowledge and expertise enabled us to approach the issues from a highly professional perspective. The government Advisors and OSD and Service staffs were also deeply involved in our deliberations and provided timely and useful responses to our questions. Each of our meetings was characterized by vigorous debate and an in-depth exploration of the critical issues. As a result, I believe the final report will generally enjoy strong support.

I recommend that you forward the report to the Under Secretary of Defense (Acquisition and Technology).

A handwritten signature in dark ink, appearing to read 'Alan B. Salisbury', is written over the printed name.

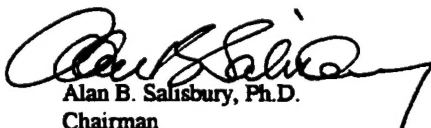
Alan B. Salisbury, Ph.D.
Chairman

Preface

This is the Final Report of the Defense Science Board Task Force on Military Personnel Information Management. This Task Force was convened at the request of the Under Secretary of Defense (Personnel and Readiness) and the Assistant Secretary of Defense (Command, Control, Communications, and Intelligence) to address specific issues and make recommendations regarding the direction the Department should take in developing and maintaining automated systems for military personnel and pay management, across the four Services, and including both active and reserve components. The Task Force met monthly beginning in February 1996, and concluded its work in August 1996.

The membership of the Task Force reflects a broad base of backgrounds relevant to the subject matter. Included are former Service personnel chiefs, former Service automation experts, former senior Department of Defense personnel and policy officials, senior academic experts on information systems, and senior information systems experts from industry.

The Task Force would like to express its appreciation to the Advisors and support staff from the military Services and Office of the Secretary of Defense, who provided superb cooperation and support throughout this effort. They contributed substantially to the content of this Final Report. It is our hope that the Services and the Department of Defense will materially benefit from this work, and that the implementation of our recommendations will result not only in significant cost savings, but in improved functional support to our Soldiers, Sailors, Airmen and Marines, who deserve the very best.



Alan B. Salisbury, Ph.D.
Chairman

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ON
MILITARY PERSONNEL INFORMATION MANAGEMENT

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**Final Report
of the
Defense Science Board Task Force
on
Military Personnel Information Management**

I. Introduction and Executive Summary.

A. Background.

The Defense Science Board Task Force on Military Personnel Information Management was established to advise the Secretary of Defense on the best automation strategy to support the military personnel and pay functions for all active and reserve components throughout the Department. Convened at the request of the Under Secretary of Defense (Personnel and Readiness) and the Assistant Secretary of Defense (Command, Control, Communications, and Intelligence), the Task Force was asked to address five items.

- 1 - Assess the Department's military personnel information management requirements and determine the most desirable, feasible, and cost-effective automation solution: for instance, one integrated active/reserve military personnel/pay system or multiple interoperable systems sharing a common database.
- 2 - Assess the cost-effectiveness of adopting and reengineering one of the Services' existing systems as the standard rather than initiating new development that may take advantage of more modern technologies, including Commercial Off The Shelf (COTS) applications.
- 3 - Evaluate the strategy being pursued by the military personnel community (OSD and the Services) which includes defining detailed requirements for data, interfaces, and functional processes for joint military personnel information management and designating the Navy and Air Force, respectively, as Executive Agents for the design and development of field and database level applications which would support core requirements.
- 4 - Assess the strategy for dealing with Service specific systems while joint military personnel information management core requirements are in development.
- 5 - Determine how to ensure that current military personnel operations are not interrupted or compromised in any way that would interfere with DoD's ability to mobilize or provide appropriate support to military personnel and veterans.

B. Overview of Task Force Activities.

The Task Force convened its organizational meeting on February 22, 1996. Task Force meetings were held on March 21/22, April 29/30, May 23, June 26, July 29, and August 21. Through the May meeting, the Task Force focused on gathering information and data relevant to the issues to be addressed. Task Force members received presentations from representatives of the Office of the Under Secretary (Personnel and Readiness), the Office of the Assistant Secretary (Command, Control, Communications, and Intelligence), the Joint Staff, the Defense Information Systems Agency, the Defense Finance and Accounting Service, the Service Personnel Chiefs, the United Kingdom Personnel Administration Agency, and private sector organizations which provide and use automation support for personnel and pay functions.

At the April meeting, issues and questions raised by Task Force members were categorized into functional, technical, and programmatic study areas. Task Force members were assigned to teams focusing on each area, with the understanding that all areas were open to all members. A detailed set of matrices was developed by OSD and Service staff to summarize the relevant information and serve as the basis for further review and discussion at the May and subsequent meetings. This set of matrices is included in the papers at Appendix H.

During the June and July meetings, Task Force members focused on recommendations and their implementation. The August meeting was devoted to reviewing the final Task Force findings and recommendations (in the form of the draft Final Report) with the Advisors (who represented the Services, the Joint Staff, and OSD).

All meetings were conducted in a completely open manner with full participation by the Advisors, and the opportunity for questions and comments from all attendees, including interested vendor organizations.

C. Summary of Conclusions and Recommendations.

The Task Force has unanimously concluded that the present situation, in which the Services develop and maintain multiple Service-unique military personnel and pay systems, has led to significant functional shortcomings (particularly in the joint arena) and excessive costs for system development and maintenance for the Department of Defense. Moreover, it is clear to the members that there are no technical, functional or programmatic barriers which preclude the realization of a common system that can support all Services and all components. These conclusions were also supported by the Services.

The Task Force also believes that, with the individual Services now in various phases of fielding or modernizing their systems, and with the Navy, in particular, newly embarked on a major system redevelopment effort, the DoD has a unique window of opportunity available to it. The immediate initiation of a common objective system

program can yield both significant savings and operational efficiencies for the Department, the Services, and the joint commanders.

The Task Force has further concluded that the best acquisition strategy for a common objective system is to vigorously pursue a COTS-based solution. Such a solution, which is strongly supported by experience in commercial industry and in ongoing Air Force and Navy efforts, will pay significant dividends in both cost and schedule.

With the collective experience and expertise of the Task Force members, and our clear understanding of the critical success factors for such a program, we have chosen to include in this report specific recommendations with regard to both the development approach (including, for instance, the use of COTS) and the management structure most likely to succeed. We believe that our report would not be complete if we did not address these vital areas.

A brief statement of the major recommendations is provided below. Additional information, including guidelines, criteria, supporting recommendations and rationale, is provided in Sections III and IV of this report.

Common Objective System: The Task Force has unanimously concluded that the Department should move to a single all-Service and all-component, fully integrated personnel and pay system, with common core software built on a COTS human resources software application base (or a modified-COTS system), with an Initial Operating Capability of 2001 or earlier. The system should incorporate standard data definitions, meet DoD technical Common Operating Environment (COE) guidelines, and include Service-specific modules as required for maximum support.

Development Approach: The Task Force members agree that the key to successful implementation is the definition of functional requirements in a joint environment. The Task Force recommends an acceleration of the process initiated by the Personnel and Readiness Military Personnel Management Joint Working Group to define functional requirements and pass them to Executive Agents for software development. The process of defining functional requirements must be performed by the personnel community, with full participation from the Services, the Joint Staff, the Defense Finance and Accounting Service (for pay integration) and OSD. Joint requirements should incorporate, to the maximum extent possible, best commercial practices as well as best Service practices, with the objectives of resolving existing functional shortcomings, minimizing Service-unique requirements, and maximizing potential COTS utilization. While the functional requirements must drive the solution, care must be taken to distinguish essential requirements from processes that may be modified without adversely impacting the function. The Service personnel system managers must look for opportunities to follow common approaches rather than pursuing Service-specific options where common solutions are clearly workable.

Management Structure: The Task Force recommends that the current USD(P&R) Information Management organization be restructured and designated as the Joint Requirements and Integration Office (JR&IO), as part of a field activity reporting to the USD(P&R). The JR&IO, augmented by the Military Personnel Management Joint Working Group (JWG), should have the overall responsibility for defining the requirements for, and directing the implementation of, the objective all-Service and all-component fully integrated personnel and pay system, under charter from the Deputy Secretary of Defense. The responsibilities of this office should include overall program authority, as well as defining and maintaining a set of common-core and Service-specific requirements for implementation by the Executive Agents. The JR&IO should coordinate with the Joint Readiness Oversight Committee (JROC) to ensure that the objective system continues to meet the needs of the CINCs, as well as the Services and OSD. The office should be responsible for programming and defending the funding for the objective system and coordinating the efforts of the Executive Agents. (Staff increases will be necessary to fulfill these responsibilities.) The JR&IO should be headed by an SES-level civilian Director.

On a monthly basis initially, and not less than quarterly, JR&IO should review the program with a Steering Committee composed of the Assistant Deputy Chiefs of Staff for Personnel (ADCSPERs) from the Services, and senior representatives from OUSD(P&R), OASD(Reserve Affairs), DFAS, and the Joint Staff. Chairmanship of the Steering Committee should rotate annually among the four Service ADCSPERs, with initial chairmanship falling to the Army. This Steering Committee should set overall priorities, and provide advice and recommendations to the USD(P&R) and the JR&IO regarding program execution throughout the life cycle process of requirements definition, software acquisition/development, hardware acquisition, fielding and follow-on maintenance functions. The Steering Committee should issue an annual written report to the Deputy Secretary of Defense providing the committee's assessment of the progress of the program.

Transition Strategy: The Task Force recommends that detailed Service-specific implementation plans for the objective system be completed by the end of FY 97. The implementation plans should include dates for phasing out existing systems, commensurate with the operational capability of the objective system. The Task Force recommends the following Service-by-Service transition strategy:

- The Army should field the Standard Installation Division Personnel System-3 (SIDPERS-3) as planned. The hardware deployed to support SIDPERS-3 should be platform-independent and should also accommodate the software of the objective system. The Army should maximize the use of existing SIDPERS-3 software in the Reserve Component Automation System (RCAS) personnel module, while deferring new development of personnel software for RCAS to permit incorporation of the objective system.

- The Navy should refocus its primary effort on developing the objective system. Without materially delaying its accelerated development and deployment schedule for critically needed NSIPS capabilities, current NSIPS efforts should be broadened to encompass the objective system requirements as they are developed by the JR&IO. Wherever possible, pressing NSIPS requirements should be satisfied through early incremental fielding of objective system modules. The Navy should continue its role as Executive Agent for the field level component of the objective system.
- The Air Force should refocus on the objective system instead of proceeding with plans to modernize its Air Force-unique field level system. The Air Force should continue its role as the Executive Agent for the corporate tier and system architecture of the objective system.
- The Marine Corps should refocus its functional and technical enhancement plans to the objective system. The Marine Corps representatives in the JR&IO/JWG should play the lead role in defining the functional requirements for effective integration of personnel and pay.

Infrastructure: The Services are in different positions with respect to modernization of their infrastructure. The Services should retain responsibility for acquiring, deploying, and maintaining the infrastructure and hardware platforms required to support the objective system. Purchase of COE-compliant platform-independent components in planned equipment modernization efforts is required, not only to support the objective system but to meet technical guidelines and to achieve the benefits of high performance.

Funding: Investment funds will be required to define functional requirements and design, develop, and test software for the objective system. The Task Force recommends that USD(Comptroller) immediately take steps to address the funding shortfalls for FY 97 and FY 98. (Exhibit 1 of Appendix A provides an estimate of funds required for the development of joint/common requirements and for the development of OSD and Joint Staff requirements and the associated software development.) Additional funding must also be identified from the Services to support definition of their unique functional requirements. Investment funds should be allocated to the Joint Requirements and Integration Office.

D. Report Contents.

Section I of this Final Report provides an Introduction and Executive Summary. Section II provides a detailed Statement of the Problem, addressing Functional Shortcomings, Excessive Costs, and Infrastructure Inadequacies in some detail. Section III identifies Significant Issues and Critical Success Factors in Functional, Technical and Programmatic areas. Section III also includes a number of recommended criteria, guidelines, and supporting recommendations and rationale that follow from the

discussion of the issues. Major recommendations are detailed in Section IV, and a recommended Assignment of Responsibilities for implementation actions is provided in Section V. (Note: While all the Appendices are on the Internet, copies of Appendices A through D are included here for the convenience of the reader.)

There are eight appendices to this report. They can be accessed on the web with the homepage address: <http://www.mpm.osd.mil>. Exhibits referenced in the main body of the report are included at Appendix A. The Task Force membership is at Appendix B. The Terms of Reference which guided the Task Force deliberations are at Appendix C. Mapping of the recommendations to the questions in the Terms of Reference is at Appendix D. The agenda for the meetings are at Appendix E and the meeting summaries at Appendix F. Appendix G contains correspondence received by and/or generated by Task Force participants relevant to the deliberations. Information papers requested by and prepared for the Task Force are at Appendix H.

II. Statement of the Problem.

The Task Force members identified three principal problem areas in military personnel management automation support: 1) functional shortcomings in the existing capabilities; 2) excessive costs in developing and maintaining largely redundant capabilities; and 3) the inadequacy of the current infrastructure relative to required operational capabilities. The Task Force agreed that any recommendations made must be designed to have a positive impact on each of these problems. Additionally, the Task Force agreed that a guiding principle should be to "do no harm." This means simply that the Task Force recommendations, when implemented, should not cause any Service to end up with functional capabilities that are inferior to, or more costly than, its current capabilities. The three problem areas (which are reflected in the individual Services to varying degrees) are summarized in the discussion that follows:

A. Functional Shortcomings.

During the Persian Gulf War, many problems highlighted the shortcomings of the existing military personnel systems in providing timely and accurate data on deployment, mobilization, and theater assets. In-theater, it was difficult for joint commanders to get information on the capabilities and locations of military personnel essential to assessments of operational capabilities. For the Services and OSD managers and analysts, it was difficult to confirm even the broadest characteristics of the individuals deployed or the mobilized force (active and reserve components). For the Service member, pay and benefits were often delayed or inaccurate and personnel records incomplete to the extent that appropriate credit was not always given for service.

Much of the discussion throughout the Task Force meetings focused on these and other functional shortcomings of existing capabilities. The degree and nature of the shortcomings, which differ across the Services, impact on: the operational managers in the joint arena (both in peacetime and in war); personnel managers in the Services; OSD managers and analysts; and the individual Service members.

There is a clear adverse impact of multiple Service-unique systems in the joint arena. In order to conduct operations and manage a fighting force, joint commanders require information that is timely, accurate, and consistent across the Services. Today, joint commanders are dependent on Service-unique personnel systems that do not provide consistent and comparable information and that vary significantly in accuracy and timeliness.

Existing systems in each of the Services provide most of the capabilities required to support the Service personnel managers. In both the Army and the Navy, however, significant problems arose in tracking personnel as they changed from reserve to active status and back and as they deployed to support contingencies on an individual basis. Both Services have initiated efforts to resolve these problems.

- The Navy is redesigning and consolidating its systems at both the headquarters and field levels to ensure a fully integrated personnel support capability.

Although this effort has only recently been initiated, both the functional and system managers are working closely with an OSD-led joint effort to define common requirements and with the Air Force to benefit from the Air Force corporate tier modernization.

- The Army is almost ready to field a new system that will provide greatly enhanced support to personnel managers for their active duty personnel.

Unfortunately, many of the fixes required to support tracking personnel in status changes and in deployment are dependent on two other modernization efforts that are not as far along: modernization of their headquarters database and modernization of their reserve component support system.

The major impacts on OSD managers and analysts mirror those on managers in the joint arena and Service personnel managers. Inconsistent information that varies significantly in accuracy and timeliness across the Services makes it difficult to develop guidance, analyze requirements, and respond to inquiries from Congress and others. While internal personnel problems present difficulties for the OSD personnel community, the financial community is also hindered by the need to work with personnel systems that provide varying degrees of accuracy and timeliness on information required to calculate and process pay for Service members.

The consequences for the individual Service members are always burdensome and sometimes painful. They include: the need to spend months in efforts to get service records straightened out (to ensure, for instance, proper credit for retirement, or proper documentation of deployment); difficulties in accessing benefits for members and their families; and delays in pay and allotments. All of these damage the morale and welfare of the Service members and their families.

While the proposed objective system may generate savings associated within the functional processes, its primary benefits should come from enhanced performance and support to the Service and joint commanders, OSD managers, and individual Service members.

B. Excessive Costs.

Considerable resources are now being expended on maintaining multiple separate Service/component systems, and significantly greater resource expenditures are required to provide for their modernization. Current cooperative efforts among the Services, particularly between the Air Force and the Navy, would indicate that there is some potential for cost reduction through voluntary initiatives; the Task Force view, however, is that such efforts by themselves are very unlikely to realize the full benefits that could result from a common system across four Services. At the same time, existing cooperation provides strong evidence that truly joint efforts are workable and can yield significant results.

There are three areas where costs should be reduced through moving to a single system: 1) future development; 2) maintenance; and 3) functional efficiencies resulting from the adoption of best practices. Each of these areas is briefly addressed below.

1. Future Development:

Substantial savings should result from the development and maintenance of a common system, although a front-end investment is required due to the initial joint requirements development effort. In total, however, this investment should be significantly less than the resources the Services could be expected to expend in pursuing their individual modernization efforts.

Although all future development costs are not reflected in the current Future Year Defense Plan (because each of the Services is currently at a different life-cycle stage), the future implications of the current practices are clear. Each Service, in turn, will reach the point where the next modernization effort must be initiated. The Army, for instance, is near completion with the software development phase of SIDPERS-3, but can be expected to be looking towards its replacement in a few years. The Navy recently completed development of the Source Data System for active duty personnel and is now pursuing the next modernization effort with NSIPS.

The historical pattern of modernization resulting from multiple systems clearly extrapolates to multiple future expenditure streams on modernization efforts. The development of a single system will require an up-front investment that will slightly exceed the modernization costs of a single Service-unique system, but will clearly be less than the aggregate of new starts that stretch out in future years. When future modernization is required, all modernization would be from a common base.

Technical experts pointed out that, even if functional requirements change during the development process, there are great technical and cost advantages associated with creating this common baseline for future modifications.

2. Maintenance:

It is difficult to differentiate fully between the savings expected from the elimination of multiple future starts and the savings expected from the need to maintain only one system. The United Kingdom Personnel Administration Agency presented expectations of cost savings of up to thirty per cent on the maintenance of a harmonized personnel and pay delivery system for their military. Similarly, the experiences of the Marine Corps and the Air Force in consolidating and integrating their systems suggest significant savings and the Functional Economic Analysis for the Navy Standard Integrated Personnel System projected savings from their internal consolidation and integration. During the life-cycle of a system, new requirements are frequently identified that result from Congressional actions, policy decisions, and opportunities for improved performance. With multiple systems, updates and revisions must be made to each

system, resulting in duplication of effort and unevenness of results. With a single system, there will be a need for a single set of updates and revisions, with a coordinated interpretation of the requirement, and a more uniform functional impact.

3. Best Practices:

The process for defining requirements for the objective system will provide an opportunity for the adoption of best practices across the Department, and in many cases from the private sector as well, as COTS packages and underlying practices are reviewed. The process also provides an opportunity for identifying inconsistencies in management due to Service-unique interpretations and implementations of policies. Although the full functional impact cannot yet be predicted, experience within the military personnel business process reengineering program has demonstrated that there are many opportunities for improving functional performance and efficiencies, and eliminating any inequities that may exist. In some cases, improved performance may be the primary goal, whether or not there are savings (for instance in providing operational support to the CINCs or in ensuring accuracy of personnel records). There will also be administrative areas where current practices can be refined in ways that will lead to efficiencies.

C. Infrastructure Inadequacies.

A final problem area, related both to the functional shortcomings and the costs, is the inability of the current infrastructure (computer system platforms) to support the full operational capabilities required for each of the Services under current plans. Much of the existing infrastructure is actually obsolete. Modernization of equipment must take place, whether joint or Service-unique, to achieve the benefits offered by high-performance, open system hardware platforms. The Army and Navy are currently planning such acquisitions. The same modern platform-independent infrastructures that are required under current plans can also be effectively used to implement the objective system.

III. Significant Issues and Critical Success Factors.

Task Force members identified several potential issues that could impact the ability of the Department to proceed in developing effective automation support for military personnel management. These potential issues fall into three main categories: functional issues; technical issues; and programmatic (scheduling, managerial and funding) issues. Each category is addressed below, along with a discussion of important considerations and critical success factors.

A. Functional Issues.

1. Joint Requirements:

In order to successfully implement consistent and effective automation support through a common system, there must be a common statement of functional requirements. This statement of requirements must clearly definitize both the common processes that are achievable and necessary, as well as the truly unique processes that are required for the individual Services to provide the essential complement of military personnel and pay support services. This statement should include: the degree to which common business practices are achievable/desirable; a full definition of the functional requirements for personnel and pay integration; and a description of an overall functional architecture. Functional requirements must also address security issues, including privacy and integrity, in both operations and communications. Short-term needs (e.g., to provide immediate relief to the field in the form of basic automation support) must be reconciled with long-term objectives.

As a tool to assist in the definitization and analysis of requirements, the Task Force noted that a number of domain analysis approaches have evolved over the past few years, particularly in support of software reuse efforts, that could be used productively in examining military personnel management. These analyses will provide insight into the personnel system structure that will support commonalities.

The Task Force received functional presentations from the Joint Staff, the Services, and OSD staff and studied the functional matrices developed in response to our questions. As noted earlier in the discussion of problems (Section II), one of the major shortcomings of the current systems is their inability to fully satisfy the requirements of the joint commanders and the Joint Staff, and, to a lesser extent, OSD managers and analysts. The Joint Personnel Asset Visibility system (JPAV), for instance, requires data from the Service systems and will clearly benefit from a common objective system. As a matter of priority, special attention needs to be paid to formally definitizing all of these requirements so the Services can respond better to them. This definitization effort should be accompanied by an equal effort and emphasis on minimizing these Joint and OSD requirements to the smallest possible set consistent with true needs.

The Task Force was impressed with the results to date, albeit in very limited functional areas, in achieving commonality in requirements between the Services, and in

the further ability to find acceptable commercial best-practice solutions as embodied in COTS human resources software (see below). The Task Force is thus confident that a common system is achievable and that a joint environment for defining a common integrated personnel and pay system will provide an opportunity for the Services, individually and collectively, to further capitalize on the best practices available (commercial or Service).

2. Joint Requirements Definition:

The experiences of the Personnel and Readiness Military Personnel Management Joint Working Group were reviewed and found to be both effective and valid as a basis for defining requirements and developing software for the objective system. The approach includes a full analysis of the military personnel management function, as defined by the existing process model. To meet an IOC date of 2001 or earlier, it will be necessary to accelerate the current processes for defining requirements and developing software. OUSD(P&R) provided an estimate of the resources required to expedite completion of these two tasks (Exhibit 1, Appendix A).

One of the assumptions made in developing both the timeline and resource estimate was that, based on the experience of the Joint Working Group, three months are required to fully develop the requirements for each of the 135 personnel management functional nodes. Through parallel efforts, the total time required for requirements development is estimated at 30 months. The Task Force believes that, with proper support and a sense of urgency, the time required per node can (and should be) reduced to two months or less.

Two alternatives were presented for staffing the process for defining functional requirements. These included a "Team" approach (with multiple teams of functional experts assigned full-time to the requirements development task for the duration of the effort), and a "Workshop" approach (with a small standing full-time team, augmented by Service subject matter experts for intensive short-term work on individual requirements). Both alternatives accelerate the current process from one module (or node) every three months to twelve modules every three months. Both alternatives assume significant contractor support, which must be supported through funding lines, and both alternatives assume continued support from the OUSD(P&R) Information Management office or some comparable organization.

The Task Force members and Advisors considered the pros and cons of each approach and concluded that the workshop approach is best. Although there may be some economies from continuity in the team approach, the workshop approach offers the opportunity to tap into the best-available functional area expertise throughout the Service personnel communities. It further offers a higher probability of buy-in to the results, since there would be greater participation by those actually responsible for providing personnel support. (Per Exhibit 1, this approach is estimated to require an office of about 60 people during an initial two and a half year period devoted to definition of requirements. After

requirements are completely defined, the staffing would be reduced to about 25 for continuing maintenance and integration functions.)

3. Personnel and Pay Integration:

Considerable discussion was devoted to the subject of personnel and pay integration. Since most compensation flows directly from data and events entered in personnel systems, it was clear to Task Force members that personnel and pay should be managed as a single system. The Task Force thus accepts and fully supports the importance of such integration, particularly as it impacts on the individual Service member's ability to get one-stop support with data entered only once for both purposes, and also with regard to eliminating the need for manual data reconciliation.

The Task Force recognizes that DFAS is the principal DoD executive agency for finance and accounting requirements, operations, systems, and functions. As such, DFAS must fully participate in the design, development, implementation and operations of the pay functionality of the objective system. As the DoD paymaster, DFAS should participate as a full partner in the development decisions of the objective system and the gap analysis to ensure that an appropriate assessment is made of commercial and Service practices with the goal of maximizing the degree of commonality and the potential use of COTS.

The Task Force members and the Advisors considered a number of ways in which personnel and pay integration could be defined. The Task Force concluded that a "fully integrated personnel and pay system" should meet the following criteria: one-time entry of data that automatically triggers all personnel and pay transactions; one-stop shopping for personnel and pay transactions for the Service members and managers; one set of fully automated edits per function; and processing that does not require manual reconciliation or intermediate data entry. From a logical standpoint, each Service would have a single personnel and pay system with a single database. From a technical or physical standpoint, modern technology and modular system development approaches may result in a system with separate (and possibly distributed) modules and/or automatically replicated/ synchronized database components. But the user must see a single, fully integrated system, providing combined personnel and pay functionality as described above.

It is important to note that integration of pay and personnel systems has significant implications for adoption of COTS. COTS evaluation and selection processes need to include appropriate criteria to ensure that a final solution meets this critical integration requirement.

4. Objective System Functional Criteria:

The Task Force believes that as a minimum, a common, integrated personnel and pay system should meet the following criteria:

- facilitate support for the joint commands by ensuring accurate and timely availability of consistent data across the Services;
- promote common definitions and understandings;
- achieve best practices and streamline processes across the Services;
- provide for one-stop shopping for personnel and pay transactions for Service members and managers, to include one-time entry of data that automatically triggers all appropriate actions;
- provide equal support, whether in garrison or deployed;
- provide for fully automated edits and processing that require no manual reconciliation or intermediate data entry;
- provide accuracy, responsiveness, timeliness and consistency of data and information availability and accessibility;
- improve security and accountability; and
- support individual Service requirements for interoperability with other Service systems.

5. COTS Functional Considerations:

The Task Force spent extensive time considering the potential benefits of a COTS-based solution. Briefings from vendors who supply COTS Human Resource software systems to government and industry were received; case studies in the literature were reviewed; and the on-going efforts by the Air Force and Navy in analyzing COTS in detail were also reviewed.

There is compelling evidence that COTS systems can satisfy a tremendous range of Human Resource (HR) and personnel requirements in diverse organizations. Major corporations, having multiple unique business units in different countries with different laws and cultures, have still managed to adopt COTS to satisfy their requirements. Most COTS solutions, however, are not totally "one-size-fits-all" in nature; rather, they have the ability to extend, modify, parameterize with tables, or otherwise accommodate unique requirements.

Clearly the four Services are separate and distinct organizations with many fundamental differences; these differences, however, are far fewer in number than their commonalities. Further, these differences are not sufficient to justify unique Service programs, and in no way preclude the development of a common objective system. The on-going "Gap Analysis" (referring to the "gap" between requirements and COTS capabilities) being conducted by the Air Force has recently resulted in an estimate that at least 60 per cent of their functional requirements can be fulfilled by an available commercial software package (Oracle Human Resources). Pending final results of such an analysis, these factors confirm that pursuing a common system for all services, based on a COTS solution, is a sound direction. Equally important, a good COTS solution can provide the capabilities for tailoring Service-unique requirements where they can be justified.

Considerations regarding the use of COTS extend beyond functionality. Additional discussion is included below in the Technical Issues area, particularly with regard to the selection process. In addition, the above discussion on personnel and pay integration indicates implications that need to be considered relative to COTS selection.

B. Technical Issues.

The Task Force received technical briefings from each of the Services on their current and planned personnel systems, and on DoD technical standards from the Defense Information Systems Agency (DISA). We studied the detailed technical matrices that were prepared in response to our questions. The Task Force agreed that there are no technical barriers to development of a common system that includes Service-unique modules required for mission support.

1. COTS Selection:

As indicated in the COTS Functional Issues discussion above, the Task Force heard from representatives of private industry on their experiences with automating personnel and pay functions and from vendors of COTS personnel and pay applications and software development tools. In addition, we examined closely the on-going efforts led by the Air Force, and followed by the Navy, in reviewing COTS systems for use in their individual personnel and pay system modernization programs. The Task Force members determined that the direction of the Air Force and Navy, towards a modified COTS solution, is not only technically feasible, but it potentially presents the best means of implementing the objective system.

Both functional and technical considerations must be applied in the process of selecting COTS. Notwithstanding the work of the Air Force and Navy, which led to the use of COTS in their current prototyping efforts, a more comprehensive review and analysis should take place before finalizing a COTS base for the objective system. The adoption of a comprehensive review and selection methodology and its proper execution must be regarded as among the critical success factors for this program.

The Chief of Research and Development from the Canadian Department of Defense has undertaken research projects to understand the problems associated with COTS-based software development from the perspective of an organization that is trying to use COTS components to build systems. They have provided, via the INTERNET, a pertinent research paper from the National Research Council of Canada Institute of Information Technology Software Engineering Group: "COTS Software Integration State of the Art" January 1996 (Exhibit 2 in Appendix A). This paper provides the characteristics of off-the-shelf based system development, current practices within both Canadian Military and NASA, experiments with open scripted architecture, and issues with COTS software integration. This paper also provides a particularly valuable guideline for accomplishing a comprehensive review and selection of COTS. A relevant case study on the evaluation and selection of a COTS HR system appeared in Datamation Magazine, June 15, 1995 (Exhibit 3 in Appendix A). The article includes a feature comparison chart and a summary "report card" that can be used as one model for the kind of review that should be done. Another evaluation model, based on "Feature Comparison Charts," is included in Exhibit 4 in Appendix A. In addition, four vendors responded to the Task Force's invitation to submit recommendations, offering their suggestions for factors to be considered in the COTS selection process (Exhibits 5, 6, 7, and 8 in Appendix A).

Because of its importance to the success of this program, and the potential implications for future competitive procurements, the Task Force has identified COTS selection as a critical success factor, and recommends that a COTS Analysis and Evaluation Plan be developed and approved as an early step in the program to arrive at the objective system. In addition to the recommended objective system functional criteria and COTS functional considerations described above, some of the factors to be considered in such a plan include:

- functionality "out-of-the-box" vs customization;
- scalability and extensibility of the COTS product;
- integration of personnel and pay functions;
- integration with multiple database options (Open Database);
- interface with open, non-proprietary, portable development tools;
- vendor experience and stability; and
- (possible) Benchmarking results.

Finally, most of the discussion of COTS has focused on the functional applications and the analyses to determine fit. Although these are important considerations, especially in determining whether or not to use COTS for a particular application within the objective system, a COTS base provides a comprehensive support

structure that is independent of the specific applications. This structure includes such elements as: data structure; replication; query capabilities; training; web access; and software services upon which tailored applications may be built. As noted in several studies, the development of software for specific applications may represent as little as 20 per cent of the total software development required to field a system. The functional gap analyses, then, are focused on a small percentage of the total software package. The recommended review and analysis of the potential for a COTS solution must take into account the benefits from the overall structure. The requirements for this structure should include: compatibility with technical and functional requirements (stated elsewhere) and the flexibility to make decisions, on a module by module basis, whether to use the available COTS application or to use compatible CASE tools to generate a more tailored application. For users, the underlying use of different approaches to different functional applications should be transparent, with both COTS and non-COTS modules fitting in to the overall COTS architecture. These different functional applications would be built on the overall COTS architecture, invoking services provided by the COTS system.

2. System Architecture:

The Task Force encourages the development of a hierarchical (layered) architecture for the objective system, similar to the style of the Common Operating Environment (COE), in which lower level modules provide services to higher level modules. These lower level modules should be common to all services and functions. Simple examples are database services, report generation services, operating system services, communication protocols and message system services. At a higher level, there should be functions that are common to all Services, such as in-processing, separation, retirement, and transfer to reserves. Some of these may need parameters that enable tailoring for differences in Service operating procedures, such as the time period for an enlistment, or time required for notice of intent to separate. These functions can then provide services to other functions that are Service-unique.

Careful thought needs to be given to the appropriate hierarchy of services. A good example of a poor choice was highlighted in the discussion of Service-unique requirements for promotion boards. All Services have a requirement to support promotion boards, but promotion board support is not a fundamental service. All promotion boards (and probably selection boards for Service schools -- and very likely similar selection committees in civilian companies) have certain generic requirements. Each needs to search the database for records that meet certain criteria to select those candidates that are eligible. For instance, there may be a need to order the records based on a simple criterion, such as date of rank, while also allowing the assignment of numeric ratings for various activities so that a rank ordered list can be created. Performing the analyses from the generic to the specific will suggest the hierarchy of services. Failure to do so will lead to many more unique modules than are necessary. In the worst case, there would be a separate system for each Service, simply operating on the same platform (which is clearly **not** what is intended).

Such an approach is critical in order to avoid the pitfall of having the new objective system crack under the weight of requirements. Each of the Services' personnel and payroll systems was itself a major software undertaking, largely due to the extensive set of requirements. By incorporating all the requirements of two major functions from four Services and the reserves without a well-designed architecture, the objective system could become hopelessly flawed.

The Task Force recognizes that there is a trade-off between the Services' desires for the preservation of existing processes that have provided functionality over perhaps many years, on the one hand, and the potential for savings in system automation, on the other. By pursuing the hierarchical analyses just outlined, the presumption will be that improved functionality and cost savings will be pursued where possible, and Service-unique functions supported only when necessary. The effect is to reverse the current presumption in favor of existing (and future) Service-unique systems. The Task Force views this as a critical step in ensuring a solution to the problems outlined in Section II.

3. Supporting Infrastructure:

Task Force members agreed that the objective system must meet DoD technical guidelines and that an underlying infrastructure must be available to achieve maximum benefits from available technology. The system platform(s) must clearly be powerful enough to provide the required services of the core system at acceptable performance levels. The complete infrastructure includes hardware, operating systems, databases, and networks. For the objective system, these components should meet the following technical criteria:

- all components must comply with the DISA-specified Common Operating Environment (COE) guidelines;
- hardware and components must be platform independent;
- DoD standard data definitions must be used;
- Commercial Off The Shelf (COTS) support software and tools should be used whenever possible, in addition to applications; and
- software development must be modular.

Task Force members are aware that decisions made today in purchasing systems will determine (or possibly limit) the capability to comply with future requirements. If the Services, in fielding their current Service-unique capabilities, purchase COE-compliant platform-independent components, the cost of this basic infrastructure will not be wasted because it can be used to implement future requirements. Investment in this modern infrastructure is required to achieve high performance benefits for the Department, independent of the need for a common military personnel management system.

C. Programmatic Issues.

Task Force members agreed that, for a number of reasons, the programmatic issues were among the most difficult to resolve. These include a schedule for a common system; transition strategies, including impacts on current Service programs; organization and management structures; and program funding.

1. IOC:

Task Force members and Advisors agreed that an Initial Operating Capability date of 2001 was both reasonable and feasible, assuming acceleration of the process for defining joint requirements. This should be viewed as a "not later than" date, and opportunities to advance the schedule should be pursued whenever they present themselves. An earlier date may also be based on an initial operating capability which represents some subset of the full set of DoD functional requirements.

2. Current Programs:

The more difficult issues include consideration of current Service personnel system programs and how to best maintain support while deliberately and efficiently moving to the objective system. Today, there are seven distinct major modernization efforts taking place in the area of core military personnel management systems:

- the Army consolidated (active and reserve) personnel database, which consolidates and replaces four existing Army databases;
- the Army active personnel field system, which replaces the current Army active field system;
- the personnel module of the Army reserve component system, which replaces two current Army personnel field systems;
- the Navy consolidated personnel (active and reserve) database, which consolidates and replaces three existing Navy databases;
- the Navy consolidated personnel (active and reserve) field system, which consolidates and replaces four existing field systems;
- the Air Force modernization of their already consolidated personnel (active and reserve) database; and
- the Air Force modernization of their already consolidated personnel (active and reserve) field system.

The Army active system, SIDPERS-3, is currently expected to begin fielding early in FY 97. The Navy and Air Force database modernization efforts are on a common track and are closely linked to existing OSD-led joint requirements effort -- both are expected to incorporate standard data and have a significant common core.

The relative immaturity of the Service personnel management system modernization programs, and, in particular, the new start being embarked upon by the Navy, create a unique window of opportunity to aggressively move to a common system now. The Task Force recommendations regarding the existing Service programs are aimed at seizing this opportunity.

3. Program Management and Organization:

The Task Force strongly believes that defining and implementing the right management structure is one of the major critical success factors for this program. Accordingly, we believe that it is implicit in our charter that we address this issue and make recommendations, based on our collective knowledge and experience.

In order to ensure success of the overall program, an organizational structure must be put in place that will meet the following criteria:

- allows for effective and complete definition of functional requirements in a joint environment that maximizes participation from the entire personnel community;
- provides a continuing mechanism for integration and coordination of maintenance activities and proposed modifications;
- provides for continuity of support for military personnel and pay management while the objective system is in development (in general);
- ensures the proper balance between efforts and resources required to develop and implement the objective system, as the first priority, and efforts and resources to provide critical interim support through existing systems (in particular); and
- provides clear lines of authority and responsibility necessary to execute the program, while ensuring that the program remains responsive to the Services who are the ultimate (primary) customers for the system.

Following extensive discussion with Service and OSD Advisors, the Task Force concluded that a three-element organizational structure will best meet these criteria.

- **Steering Committee.** A new Steering Committee would be established, consisting of the Assistant Deputy Chiefs of Staff for Personnel (ADCSPERs) from the Services, and senior representatives from OUSD(P&R), OASD(Reserve Affairs), DFAS, and

the Joint Staff. This Steering Committee would set overall priorities, and provide advice and recommendations to the USD(P&R) and the program office (JR&IO) on program execution throughout the system life cycle. Chairmanship of the Steering Committee would rotate annually among the four Service ADCSPERs.

- **Joint Requirements and Integration Office.** A Joint Requirements and Integration Office (JR&IO), reporting to the OUSD(P&R), would have overall responsibility for development and maintenance of system requirements as well as for program execution. This office would also coordinate the development efforts of the Executive Agents and monitor program progress. The JR&IO should review the program with the Steering Committee on a monthly basis initially, and at least quarterly thereafter (as determined by the Steering Committee).
- **Executive Agents/Services/DFAS.** The Executive Agents would accomplish all system development and maintenance work, with program management and acquisition responsibilities for their designated systems. In addition, the Services would have total responsibility for their fielded systems. Consistent with DoD policy, the Defense Finance and Accounting Service (DFAS) would continue to have operational responsibility for the fielded pay portions of the objective system.

Disagreements that arise during the project should be addressed first by the existing Joint Integration Group (JIG). If the JIG cannot resolve an issue, it should be referred to the Steering Committee for its recommendation, and then to the existing Policy Review Committee. The Policy Review Committee should meet as required to resolve those issues.

The objective system should adhere to all DoD acquisition life-cycle requirements, including appropriate oversight by the Major Automated Information System Review Council (MAISRC). Within DoD, the ASD(C3I), through the MAISRC, supervises the acquisition management responsibilities of all major information systems. Since DoD policies have recently been rewritten to streamline the layers of oversight, the Executive Agents should be designated as Joint Program Managers for their elements of the objective system and report to the MAISRC through their respective Service acquisition hierarchies, with full participation and coordination from the JR&IO to ensure that the full intent of the common system is implemented. The JR&IO should be the sponsor for all MAISRC reviews.

The Task Force strongly believes that the JR&IO must be organized as soon as possible, with a target date of October 31, 1996. Since it normally takes up to a year to appoint a new SES, we recommend that the Director (IM) in OUSD(P&R) be appointed as acting or interim director, in order to ensure a smooth transition from current activities to the accelerated, more comprehensive program outlined in this report.

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IV. Recommendations.

Major recommendations and the underlying rationale are provided below. (Additional information, to include implementation guidelines, criteria, and supporting rationale and recommendations, can be found in Section III.)

A. Recommendation on the Objective System.

The Task Force members and Advisors, along with the Under Secretary (Comptroller), the Under Secretary (Personnel and Readiness) and the Assistant Secretary (Command, Control, Communications and Intelligence), reached consensus that the Department should move to a single all-Service and all-component, fully integrated personnel and pay system, with an Initial Operating Capability of 2001 or earlier.

The objective military personnel management system should be based on a common core set of functional modules that accommodates Service specific requirements as needed. This common system would consist of three sets of modules:

Set 1 - truly "common" modules which are used by all Services (and all components) for those functions which can be identical;

Set 2 - "multi-Service" modules which have a common core of functionality, but include limited variant processes for each of the Services as necessary and appropriate, to be used by all Services for those functions which are very similar, but not identical; and

Set 3 - "Service-unique" modules for those functions which require unique processes for any or all of the Services.

For each Service, the fielded system would include all of Set 1, all (or most) of Set 2, and its subset of Set 3. Taken together, Sets 1 and 2 should comprise the majority of each fielded system (in excess of 80 per cent as a target), with Set 3 (Service-unique) being a relatively small component. This approach is consistent with the emerging results of on-going efforts by the Personnel and Readiness Military Personnel Management Joint Working Group and the Services.

The Task Force defines a "fully integrated personnel and pay system" as one which meets the following criteria: one-time entry of data that automatically triggers all personnel and pay transactions; one-stop shopping for personnel and pay transactions for the Service members and managers; one set of fully automated edits per function; and processing that does not require manual reconciliation or intermediate data entry. From a logical standpoint, each Service would have a single personnel and pay system with a single database. From a technical or physical standpoint, modern technology and modular system development approaches may result in a system with separate (and possibly distributed) modules and/or automatically replicated/synchronized database components.

But the user must see a single, fully integrated system, providing combined personnel and pay functionality.

By its recommendation for a common system, the Task Force is not recommending a centrally operated or managed system. While the development and maintenance functions for the software should be integrated and consolidated, ownership, operation, and management of the fielded systems should remain with the Services.

B. Recommendations on the Development Approach.

The preliminary work of the Personnel and Readiness Joint Working Group for Military Personnel Management has demonstrated that, with full Service participation, consensus on functional requirements for a common system can be achieved. The Service Advisors to the Task Force have confirmed the success of this process.

The Task Force recommends an acceleration of the process initiated by the Personnel and Readiness Military Personnel Management Joint Working Group to define functional requirements and pass them to Executive Agents for software development. The process of defining functional requirements must be performed by the personnel community, with full participation from the Services, the Joint Staff, the Defense Finance and Accounting Service (for pay integration) and OSD. To complete this process, the Task Force recommends the "Workshop" approach discussed in Section III (and in Exhibit 1 at Appendix A). Joint requirements should incorporate, to the maximum extent possible, best commercial practices as well as best Service practices, with the objective of minimizing Service-unique requirements and maximizing potential COTS utilization.

The Task Force places the selection of system architecture, which addresses software and supporting infrastructure, as a matter of high priority, concurrent with defining functional requirements. To this end, the Task Force recommends pursuit of a COTS system as the basis of the objective system. As a first step in this direction, the Task Force recommends that a COTS Analysis and Evaluation Plan be developed and approved. Guidance for this plan is contained in Section III (see COTS Selection). A decision on a specific COTS package and/or development approach using Computer Assisted Software Engineering tools should be made early, preferably within three months of the establishment of the JR&IO. The Task Force further recommends the development of a hierarchical (layered) system architecture, and selection of supporting infrastructure in accordance with the DISA Common Operating Environment as also detailed in Section III.

C. Recommendations on a Transition Strategy.

A detailed implementation plan and schedule must be developed for each Service that provides for a smooth and timely transition to the objective system. These schedules cannot be defined in complete detail until the process of requirements definition has progressed further. Assuming the acceleration of requirements definition and software development as outlined above, these detailed implementation plans should be in place

within one year of the initiation of the accelerated requirements development effort. Pending development of the detailed implementation plans, the Task Force recommends the following high-level strategy.

Army. The software development phase of SIDPERS-3 is essentially complete. Fielding of SIDPERS-3 should continue as planned within the Army, giving the Army a much needed modernized infrastructure. The hardware deployed to support SIDPERS-3 should be platform-independent and should also accommodate the software of the objective system. Maximum use of SIDPERS-3 software should be made in fielding an RCAS personnel module, while development of new personnel software for RCAS should be done as part of the objective system, which should support both active and reserve Army components. Any future purchases of hardware to support the Army reserve components should ensure that the objective system software can also be accommodated.

Navy. The Navy is at the early stages of development of their modernized systems (both field level and database). It is the best positioned of the Services to take full advantage of the objective system. The Navy should, therefore, refocus its primary effort on developing the objective system. Without materially delaying its accelerated development and deployment schedule for critically needed NSIPS capabilities, current NSIPS efforts should be broadened to encompass the objective system requirements as they are developed by the JR&IO. Wherever possible, pressing NSIPS requirements should be satisfied through early incremental fielding of objective system modules. The Navy should continue its role as Executive Agent for the field level component of the objective system.

Air Force. The Air Force is near completion of the modernization of its corporate tier and system architecture. This effort uses modified COTS and may have relevance for the objective system. The Air Force should not proceed with independent modernization of its field level system, but should refocus on implementing and adopting the objective system. The Air Force should continue its role as Executive Agent for the corporate tier and system architecture for the objective system.

Marine Corps. The Marine Corps has not planned a major modernization effort, but is planning several enhancements to its existing system. Except for the year 2000 fix, which must be completed prior to 2000, the Marine Corps enhancements should be identified as requirements for the objective system and should not be undertaken separately. The Marine Corps should thus refocus its functional and technical enhancement plans on the objective system. The Marine Corps representatives in the JR&IO/JWG should further take the lead role in developing those functional requirements for the objective system that pertain to the integration of pay and personnel functionality.

In short, the Task Force recommends that all planned new modernization efforts be refocused on the objective system.

D. Recommendations on Management.

An effective management structure is essential to ensure effective guidance and management of the development and maintenance of the objective system. The structure should further ensure that the personnel community, in OSD and the Services, maintains control of both the definition of requirements and the maintenance functions.

The Task Force has elicited complete agreement from the personnel community and the USD(Comptroller) that the objective system should be a fully integrated personnel and pay system. Within DoD, however, there is currently no appropriate structure to oversee and manage the joint development of combined military pay and personnel management automation support.

Accordingly, a three-element management structure is recommended:

Program Office (JR&IO): The Task Force recommends that the current USD(P&R) Information Management organization be restructured and designated as the Joint Requirements and Integration Office (JR&IO), as part of a field activity reporting to the USD(P&R). The responsibilities of this office should include overall program authority, as well as defining and maintaining a set of common-core and Service-specific requirements for implementation by the Executive Agents. (Staff increases will be necessary to fulfill these responsibilities.) The JR&IO should be headed by an SES-level civilian Director.

As soon as possible (target first quarter, FY97), the JR&IO, augmented by the Military Personnel Management Joint Working Group, should assume full responsibility for defining the requirements for, and directing the implementation of, the objective all-Service and all-component fully integrated personnel and pay system, under charter from the Deputy Secretary of Defense. In addition to the existing responsibilities of the OUSD(P&R) Information Management Office, JR&IO responsibilities should include:

- reviewing and defining all functional requirements for the objective system;
- coordinating the efforts of the Executive Agents;
- developing performance criteria for and evaluating performance of the objective system;
- analyzing reasonable policy alternatives for enhanced functionality and savings;
- defining requirements for, and programming all funds related to, developing and maintaining the objective system in the PPBS cycle, in coordination with the Executive Agents;
- ensuring the successful fielding by the Services of the objective system; and
- preparing an annual report to the Deputy Secretary of Defense on what progress is being made in development of the objective system.

The JR&IO must ensure that the common core meets functional requirements and minimizes wasteful duplication of systems development. This means that it should

operate under the explicit guideline of minimizing the need for Service-unique functions, and hence maximizing the common core. The charter should state that the Services must make the case for separate requirements on a case-by-case basis as the office goes through the 135 nodes of military personnel management. The JR&IO should coordinate with the JROC to ensure that the objective system continues to meet the needs of the CINCs, as well as the Services and OSD. The JR&IO should also serve as the coordinating point for integrating policy between and among OSD functional representatives of the principal staff assistants, the Services, and technical representatives in OSD and the Defense Agencies.

As mentioned above, the JR&IO staff should be augmented by the Joint Working Group during the initial phase of requirements definition, to fully define requirements for the entire military personnel management function, following the "workshop" approach described in Section III (and Exhibit 1 in Appendix A). The Joint Working Group should include full-time representation from all Service components, the Joint Staff, OUSD (Personnel and Readiness), and the Defense Finance and Accounting Service. After the initial phase is completed, the Joint Working Group should be eliminated and the office should be maintained at the minimum size sufficient to ensure that maintenance, enhancements and future modernization are effectively managed in a joint environment.

Steering Committee: On a monthly basis initially, and not less than quarterly, the JR&IO should review the program with a Steering Committee composed of the Assistant Deputy Chiefs of Staff for Personnel (ADCSPERs) from the Services, and senior representatives from OUSD(P&R), OASD(Reserve Affairs), DFAS, and the Joint Staff. Chairmanship of the Steering Committee should rotate annually among the four Service ADCSPERs, with initial chairmanship falling to the Army. This Steering Committee should set overall priorities, and provide advice and recommendations to the USD(P&R) and the JR&IO regarding program execution throughout the life cycle process of requirements definition, software acquisition/development, hardware acquisition, fielding and follow-on maintenance functions. The Steering Committee should issue an annual written report to the Deputy Secretary of Defense providing the committee's assessment of the progress of the program.

Executive Agents/Services. All program management, system development, and maintenance should be done by the Executive Agent program management offices. The Executive Agents should also be responsible for defining the resources required for them to fulfill their responsibilities. Formal agreements with Executive Agents should be signed, with the understanding that the agents report to the Joint Requirements and Integration Office for development and maintenance of these systems. The Services should prepare BES documentation on the basis of guidance issued in the POM cycle and would be responsible for acquisition of all systems.

E. Recommendations on Funding.

Beginning in FY 97, investment funds will be required to define functional requirements and design, develop, and test software for the objective system. The Task

Force recommends that USD(Comptroller) immediately take steps to address the funding shortfalls for FY 97 and FY 98. (Exhibit 1 of Appendix A provides an estimate of funds required for the development of joint/common requirements and for the development of OSD and Joint Staff requirements and the associated software development.) Additional funding must also be identified from the Services to support development of their unique functional requirements. Personnel and investment funds should be allocated to the Joint Requirements and Integration Office. (This will require direction from the Deputy Secretary.)

V. Assignment of Responsibilities.

To ensure that the recommendations of the Task Force are carried out in a timely manner, this section identifies the specific actions that should be taken, when, and by whom, consistent with recommendations in Section IV.

A. Establish the Joint Requirements and Integration Office. By October 31, 1996, the Office of the Under Secretary (Personnel and Readiness), with support from the Services and the Office of the Under Secretary (Comptroller), should prepare a Deputy Secretary of Defense charter for the Joint Requirements and Integration Office as part of a field activity of the OUSD(P&R). (As an alternative, it may be appropriate to revise the USD(P&R) Charter to include the JR&IO and its responsibilities.) Since it normally takes up to a year to appoint a new SES, we recommend that the Director (IM) in OUSD(P&R) be appointed as acting or interim director, in order to ensure a smooth transition from current activities to the accelerated, more comprehensive program outlined in this report. Also by October 31, 1996, the charter of the existing Joint Working Group should be revised and extended as required to augment the JR&IO during the requirements definition period.

B. Establish the Steering Committee. By October 31, 1996, the Office of the Under Secretary (Personnel and Readiness), with support from the Services, the Office of the Under Secretary (Comptroller), and the Office of the Assistant Secretary (Command, Control, Communications, and Intelligence), should establish and charter the Steering Committee to set overall priorities and provide advice and recommendations to the USD(P&R) and the Joint Requirements and Integration Office both for development and maintenance functions.

C. Acquire Funds. The Office of the Under Secretary (Personnel and Readiness), with support from the Office of the Under Secretary (Comptroller), should prepare necessary documents to acquire funds to support the definition of requirements and design, development, and testing of software for the objective system, to begin in October of 1996. (The Task Force recommends that the funding be allocated to the Joint Requirements and Integration Office.)

D. Prepare Requirements Definition Schedule. By January 31, 1997, the Joint Requirements and Integration Office, through the Office of the Under Secretary (Personnel and Readiness), should submit to the Steering Committee a schedule for completing requirements definition in time for an IOC of the objective system by or before 2001. The schedule should include the schedule of workshops, prioritized to ensure the maximum potential for early deployment.

E. Charter Executive Agents. By October 31, 1996, the Office of the Under Secretary (Personnel and Readiness), in coordination with the Services, the Office of the Under Secretary (Comptroller), and the Office of the Assistant Secretary (Command, Control, Communications, and Intelligence), should expand the

existing charters of the Executive Agents to design, develop, and test the software for the objective system.

F. Prepare Software Design, Development, and Testing Plan and Schedule.

By November 30, 1996, the Executive Agent Program Managers, through the Director of the Joint Requirements and Integration Office should submit to the Steering Committee a plan and initial schedule for design, development, and testing of software. These plans should include preparation of appropriate acquisition documents, as required.

G. Support the Functional Workshops. The process for defining functional requirements for the objective system requires full participation from functional experts throughout the personnel community and, for pay integration functions, the finance community. The Services, the Joint Staff, and the Defense Finance and Accounting Service should provide appropriate subject matter experts to the workshops as required.

H. Prepare Implementation Plans. By September 30, 1997, the Services must submit to the Under Secretary (Personnel and Readiness) and the Assistant Secretary (Command, Control, Communications, and Intelligence) individual implementation plans for moving to the objective system.

I. Complete COTS Review and Analysis. By January 31, 1997, the review and analysis of COTS candidates should be completed in accordance with an approved COTS Analysis and Evaluation Plan. An Integrated Process Team (IPT), established and coordinated by the JR&IO, (including the two Executive Agents and representatives from OASD(C3I), the Services, and DFAS) should develop and implement this plan and agree on a common approach for the use of COTS software in the objective system. The review and analysis should consider and build on the studies already under way by the Air Force and Navy.

LISTING OF APPENDICES

- **All appendices (A through H) and the Final Report are located on the Internet at <http://www.mpm.osd.mil>**
- **Appendices A through D included in this document for the convenience of the reader**

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DESCRIPTION OF APPENDICES

All appendices (A through H) and the Final Report are located on the Internet at <http://www.mpm.osd.mil>

Appendices A through D included in this document for the convenience of the reader

Appendix A: Exhibits

This appendix contains the documents referenced in the DSB Task Force Final Report. They include:

- A-1. Acceleration of Design and Development of Common Military Personnel/Pay Management Objective System - Resources Required (revised 8/31/96)
- A-2. Using COTS Software In Systems Development from National Research Council of Canada, Institute for Information Technology, Software Engineering Group (Copyright 1996)
- A-3. "Retool Human Resources" and "HR App Meets Critical Needs" articles from Datamation Journal, (6/15/95)
- A-4. Defense Science Board Military Personnel and Pay System Task Force Commercial Off The Shelf (COTS) Feature Comparison Charts (8/8/96)
- A-5. Ms. Padalino's memo with SYBASE input to the Defense Science Board Task Force on Military Personnel Information Management Report - BAFO, (8/7/96)
- A-6. Mr. Selsor's memo with GRCI input to the Defense Science Board Task Force on Military Personnel Information Management Report - BAFO, (8/7/96)
- A-7. BG Pellicci's (USA, Ret) memo with ORACLE input to the Defense Science Board Task Force on Military Personnel Information Management Report - BAFO, (8/6/96)
- A-8. Mr. Larry Rinderknecht memo with EDS input to the Defense Science Board Task Force on Military Personnel Information Management Report - BAFO, (8/20/96)

Appendix B: Task Force Participants

This list contains the names, positions, and company or government affiliations of the: members, advisors, executive secretaries, and staff support for the Defense Science Board Task Force on Military Personnel Information Management.

Appendix C: Terms of Reference

This USD (A&T) memorandum dated February 23, 1996 and addressed to the Chairman of the Defense Science Board defines the Terms of Reference for the Task Force on Military Personnel Information Management.

Appendix D: Recommendations Mapped to Terms of Reference Tasks

This summarizes the Task Force recommendations relative to the five major issues defined in the Terms of Reference.

Appendix E: Agenda

This appendix contains the agenda for all meetings of the DSB Task Force on Military Personnel Information Management. The first four meetings focused on defining and gathering information for the Task Force members. The last three meetings focused on formulating and documenting conclusions and recommendations. The meeting dates were:

- February 22, 1996
- March 21-22, 1996
- April 29-30, 1996
- May 23, 1996
- June 26, 1996
- July 29, 1996
- August 21, 1996

Appendix F: Meeting Summaries

This appendix provides summaries of each Task Force meeting. Meeting dates and the lists of attachments to each summary are listed below:

- F-1. February 22, 1996
- February Meeting Summary (3/22/96) & Attachments:
 - Attendance Sheet
 - Agenda
 - Dr. Salisbury's Task Analysis Chart
- F-2. March 21-22, 1996
- March Meeting Summary (4/29/96) & Attachments:
 - Attendance Sheet
 - Agenda
- F-3. April 29-30, 1996
- April Meeting Summary (5/23/96) & Attachments:
 - Attendance Sheet
 - Agenda
- F-4. May 23, 1996
- May Meeting Summary (6/26/96) & Attachments:
 - Attendance Sheet
 - Agenda
 - Dr. Salisbury Briefing Slides - Vision/Issues/Problems
- F-5. June 26, 1996
- June Meeting Summary & Attachments:
 - Attendance Sheet
 - Agenda
 - Dr. Salisbury Slides - Benefits/Objectives of Common Core System

Appendix F: Meeting Summaries (cont'd)

F-6. July 29, 1996

- July Meeting Summary & Attachments:
 - Attendance Sheet
 - Agenda

F-7. August 21, 1996

- August Meeting Summary & Attachments:
 - Attendance Sheet
 - Agenda

Appendix G: Correspondence

Memoranda, letters, and other correspondence originating from, addressed to, or commenting on the DSB Task Force are contained in this appendix. Attachments referenced are generally included elsewhere in Appendices E, F, and H.

- G-1. Mr. Dorn's memorandum to the Services' Assistant Secretaries (M&RA) and USD(C), (2/7/96)
SUBJECT: DSB Task Force on Military Personnel Management
- G-2. Dr. Salisbury's letters to Task Force Members, (2/14/96)
SUBJECT: Welcome/First Meeting
- G-3. Mr. Kaminski's memorandum to DSB Chairman, (2/23/96)
SUBJECT: Terms of Reference --DSB Task Force on Military Personnel Information Management
- G-4. Mr. Janak's letter to Dr. Salisbury, (3/12/96)
SUBJECT: DSB Task Force on Military Personnel Information Management
- G-5. Dr. Salisbury's letters to Briefers, (3/14/96) - RADM Gauss, Al Munson (TRW), RADM Froman (J-1), Richard Keevey (DFAS), BG Smith, Mr. Patel (TRW), Jeff Carr (PeopleSoft), Col Keller, BG Pellicci (ORACLE), and Michael Cavander (EDS)
SUBJECT: Briefing Guidelines
- G-6. Ms. St. Claire's note to DSB Participants, (3/14/96)
SUBJECT: Read-Ahead for March 21-22 Meeting of the DSB Task Force
- G-7. Dr. Dahlman's note to Dr. Salisbury, (3/27/96)
SUBJECT: Suggestions for DSB/MPIM
- G-8. Ms. St. Claire's note to DSB Participants, (4/19/96)
SUBJECT: Task Force Meeting of April 29/30 (Read-Ahead)

Appendix G: Correspondence (cont'd)

- G-9. Ms. St. Claire's note to DSB Participants, (4/24/96)
SUBJECT: Additional Read-Ahead Materials for Task Force Meeting of April 29/30
- G-10. Dr. Salisbury's letters to Task Force Members, (5/8/96)
SUBJECT: Three Task Force Working Groups
- G-11. Dr. Salisbury's letter to Mr. Hamre, USD(C), (5/14/96)
SUBJECT: Invitation to discuss Personnel/Pay Integration
- G-12. Ms. St. Claire's note to DSB Task Force on Military Personnel Information Management, (5/15/96)
SUBJECT: Read-Ahead Materials for May 23 Meeting
- G-13. Ms. St. Claire's note to DSB Members, (5/17/96)
SUBJECT: Summary Matrices, (Rev. 5/17/96 - Changes were highlighted in yellow)
- G-14. Ms. St. Claire's note to Joint Integration Group, (5/17/96)
SUBJECT: Additional Information (e.g., process flows) for Task Force Members
- G-15. Mr. Dougherty's (Air Force Reserve) memorandum to Ms. St. Claire, (5/21/96)
SUBJECT: Additional Information for Task Force Members
- G-16. Ms. St. Claire's note to DSB Task Force on Military Personnel Information Management, (5/30/96)
SUBJECT: Draft Statement
- G-17. Dr. Salisbury's letters to Task Force Members, (6/14/96)
SUBJECT: Objective Common System for the DoD military personnel systems
- G-18. Ms. St. Claire's note to DSB Task Force Members and Advisors, (6/19/96)
SUBJECT: Read-Ahead Materials for the June 26 meeting
- G-19. LtGen Christmas memorandum to Mr. Hamre, USD(C), (6/24/94)
SUBJECT: MPM-21 and DSB Task Force Activities on Personnel Management
- G-20. LtGen Christmas memorandum to Mr. Dorn, USD(P&R), (6/24/94)
SUBJECT: MPM-21 and DSB Task Force Activities on Personnel Management
- G-21. Mr. Dorn's memorandum to LtGen Christmas, (7/26/96)
SUBJECT: MPM-21 and DSB Task Force Activities on Personnel Management
- G-22. Mr. Janak's letter to Dr. Salisbury, (6/25/96)
SUBJECT: Single Integrated HR/Payroll System for DoD

Appendix G: Correspondence (cont'd)

- G-23. LtGen Lukeman's (USMC, Ret) letter to Dr. Salisbury, (6/28/96)
SUBJECT: Marine Corps Perspective
- G-24. Mr. Dorn's letter to Air Commodore Winsland, (7/10/96)
SUBJECT: Appreciation for Group Captain Upham's Task Force Participation
- G-25. Ms. St. Claire's letter and note to BG Jack Pellicci, USA (Ret), (7/10 & 7/11/96 respectively)
SUBJECT: ORACLE questions
- G-26. BG Jack Pellicci's (USA, Ret) response to Ms. St. Claire's questions, (7/25/96)
SUBJECT: ORACLE answers
- G-27. Ms. St. Claire's note to DSB Task Force Participants, (7/24/96)
SUBJECT: Meeting on July 29, 1996 at the Crystal City Sheraton Hotel (Read-Ahead)
- G-28. Dr. Salisbury's letters to DSB Task Force Participants with two attachments, (7/24/96):
- LtGen Ludwig's (USAF, Ret) fax, (7/14/96)
SUBJECT: Joint PMO Discussion Briefing
 - LtGen Lukeman's (USMC, Ret) letter, (7/15/96)
SUBJECT: Comments on LtGen Ludwig's fax
- G-29. Mr. Bemis' memorandum to Dr. Salisbury, (7/25/96)
SUBJECT: Defense Science Board Task Force on Military Personnel Information Management
- G-30. Dr. Salisbury's letter to Mr. Bemis, (7/29/96)
SUBJECT: Defense Science Board Task Force on Military Personnel Information Management
- G-31. Dr. Dahlman's note to DSB Task Force Members, (7/26/96)
SUBJECT: OSD Field Agency
- G-32. Ms. St. Claire's note to DSB Task Force Participants, (7/29/96)
SUBJECT: Meeting of July 29, 1996
- G-33. Dr. Salisbury memorandum to DSB Task Force Members, (7/29/96)
SUBJECT: Inputs for Draft Report
- G-34. Ms. St. Claire's note to DSB Task Force Participants, (8/15/96)
SUBJECT: Next Meeting (August 21 Read-Ahead)

Appendix G: Correspondence (cont'd)

G-35. Brief and Final Observations provided to Dr. Salisbury as input for Final Report:

- G-35.a) RADM Gunn's memo with Navy input to the Defense Science Board Task Force on Military Personnel Information Management Report -BAFO, (8/2/96)
- G-35.b) MG Vollrath's memo with Army input to the Defense Science Board Task Force on Military Personnel Information Management Report - BAFO, (8/5/96)
- G-35.c) LtCol Westcott's memo with Marine Corps input to the Defense Science Board Task Force on Military Personnel Information Management Report - BAFO, (8/6/96)
- G-35.d) Ms. Grese's memo with Air Force input to the Defense Science Board Task Force on Military Personnel Information Management Report - BAFO, (8/6/96)
- G-35.e) BG Pellicci's (USA, Ret) memo with ORACLE input to the Defense Science Board Task Force on Military Personnel Information Management Report - BAFO, (8/6/96)
- G-35.f) Mr. Selsor's memo with GRCI input to the Defense Science Board Task Force on Military Personnel Information Management Report - BAFO, (8/7/96)
- G-35.g) Ms. Padalino's memo with SYBASE input to the Defense Science Board Task Force on Military Personnel Information Management Report - BAFO, (8/7/96)
- G-35.h) Mr. Larry Rinderknecht memo with EDS input to the Defense Science Board Task Force on Military Personnel Information Management Report - BAFO, (8/20/96)

G-36. Final Comments on Draft Report of the DSB Task Force on Military Personnel Information Management

- G-36.a) Mr. Keevey's memo to Director, IM, OUSD (P&R) with DFAS comments (8/27/96)
- G-36.b) MG Vollrath's memo to Chairman, DSB Task Force on Military Personnel Information Management with Army comments (8/27/96)

Appendix G: Correspondence (cont'd)

- G-36.c) Ms. Grese's letter to Dr. Salisbury with Air Force comments (8/27/96)
 - G-36.d) Ms. Howell's memo to Chairman, DSB Task Force on Military Personnel Information Management with Marine Corps comments (8/27/96)
 - G-36.e) RADM Gunn's memo to Chairman, DSB Task Force on Military Personnel Information Management with Navy comments (8/27/96)
 - G-36.f) RADM Froman's memo to OUSD for Personnel & Readiness with Joint Staff comments (8/28/96)
- G-37. Army, Air Force, and Navy Times Articles (7/96) on the Defense Science Board Task Force on Military Personnel Information Management

Appendix H: Selected Information Papers

The information papers in this appendix were presented or referenced at the DSB Task Force meetings. They include:

- H-1. Military Personnel and Readiness Information Management Program Strategic Plan (Rev. 12/95): a summary of the P&R strategic plan prior to the deliberations of the Task Force.
- H-2. Summary of Military Personnel Information Management Issue (4/17/96)
- H-3. Questions and Answers from the DSB Task Force (4/24/96)
- H-4. Summary Services' Matrices (Final Version 7/29/96)
 - Database/System Notes
 - Definitions of Functional Matrix
 - Definitions of Programmatic Matrix
 - Definitions of Technical Matrix
 - Functional Summary Matrix with Notes
 - Programmatic Summary Matrix with Notes
 - Technical Summary Matrix with Notes
 - Services POM Summaries
 - Total Military Personnel Function Costs Information Paper
 - Acronyms for Matrices

Appendix H: Selected Information Papers

- H-5. Services' Modernization Plans Information Papers for the May 23 DSB Task Force Meeting
 - Army
 - Navy (NMPDB & NSIPS)
 - Marine Corps
 - Air Force
- H-6. Promotion Process: Two Versions of Data Flow (5/22/96)
- H-7. Acceleration of Design and Development of Common Military Personnel/Pay Management Objective System - Resources Required (revised 8/31/96)
- H-8. Summary of Principal Staff Assistants (PSAs) Information Management Responsibilities (2/95)
- H-9. The Planning, Programming, & Budgeting System (PPBS) (4/24/96)
- H-10. Acquisition Process for Major Automated Information Systems (MAIS) (4/24/96) and Defense Acquisition Policy (Executive Summary 2/28/96)
- H-11. Congressional Language Affecting Military Personnel Information Management Programs (5/96)
 - NSIPS
 - SIDPERS-3
 - RCAS
- H-12. Civilian Personnel/Payroll Private Sector Benchmarking Survey - Final Report - (Executive Summary) (9/21/94)
- H-13. Study of Options for the Future Management of the Services: Personnel Administration and Pay Delivery Systems (Executive Summary) (12/1/95)
- H-14. Acronym/Term Listing for the Defense Science Board Task Force on Military Personnel Information Management (Rev. 7/29/96)
- H-15. Defense Information Infrastructure (DII) Common Operating Environment (COE) Integration and Runtime Specification (I&RTS) - Preliminary Report, Version 2.0, (Executive Summary) (October 23, 1995)
- H-16. Business Process Improvements Summary - Military Personnel Information Management Program (Update: 2/8/96)
- H-17. Annotated Bibliography of Selected Reports for Military Personnel Information Management Program (2/96)

APPENDIX A: EXHIBITS

This appendix contains the documents referenced in the DSB Task Force Final Report. They include:

- A-1. Acceleration of Design and Development of Common Military Personnel/Pay Management Objective System - Resources Required (revised 8/31/96)
- A-2. Using COTS Software In Systems Development from National Research Council of Canada, Institute for Information Technology, Software Engineering Group (Copyright 1996)
- A-3. "Retool Human Resources" and "HR App Meets Critical Needs" articles from Datamation Journal, (6/15/95)
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- A-5. Ms. Padalino's memo with SYBASE input to the Defense Science Board Task Force on Military Personnel Information Management Report - BAFO, (8/7/96)
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- A-8. Mr. Larry Rinderknecht memo with EDS input to the Defense Science Board Task Force on Military Personnel Information Management Report - BAFO, (8/20/96)

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**Acceleration of Design and Development of
Common Military Personnel/Pay Management
Objective System**

Resources Required

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QUESTION: What resources would be required to complete the functional definition and software development of an objective military personnel/pay management system with an IOC of 2001?

This outline focuses only on this question. It does not address other critical factors, such as programmatic issues, management structure, and implementation. The estimates provided below are based on two staffing alternatives and the requirements definition approach currently in use by the Joint Working Group. Manpower estimates are only for definition of functional requirements and do not include personnel attached to the Executive Agents.*

Background. At the Defense Science Board Task Force meeting on June 26, participants agreed that it should be both functionally and technically feasible to design and develop a common system (that would accommodate Service-specific requirements) with an IOC of 2001. It was recognized that this would require an acceleration of the current process for defining requirements and developing software. P&R was asked to provide an estimate of the resources required to complete these two tasks. It was also recognized that additional factors would need to be considered, such as the management structure, funding and reporting lines, Service-specific implementation plans, and the extent to which hardware currently being purchased by the Services could be used to deploy the objective system.

Assumptions. The requirements defined below are based on the following assumptions.

1. Military personnel management is the broad functional area defined by the 135 nodes of the process model developed by the Joint Working Group.
2. Resource-intensive case tools will continue to be used to define functional requirements.
3. The Joint Working Group experience that three months are required to complete functional definitions for each node, from initiation to hand-off to the software development team.
4. The Services will continue to be the primary drivers in development of requirements.
5. The Executive Agents (USN and USAF) for the prototype effort will continue as Executive Agents for the full development.
6. The accelerated program will require additional personnel for 2.5 years, beginning in October of 1996, after which a permanent, much smaller staff will remain in place for continued maintenance and updates.

Timeline. The timeline was developed working backwards from an IOC date of 2001. The proposed timeline is at chart 1.

Approach. The approach builds on and accelerates the work of the Joint Working Group and the P&R Information Management office.

1. Functional requirements will be incorporated modularly, with precedents.
2. Requirements will be analyzed concurrently rather than sequentially and passed to developers as modules are completed.

Staffing Alternatives. Two alternatives are presented for staffing the process for defining functional requirements. Both alternatives accelerate the current process from one module (or node) every three months to twelve modules every three months. Both alternatives assume significant contractor support, which is provided through the funding lines, and both alternatives assume continued support from the Information Management (IM) office or some comparable organization.

- Workshop approach: This alternative follows the pattern that the Joint Working Group has been using for requirements definition. Subject matter experts are brought in from the Services for two-week intensive workshops. Members of the JWG participate in each workshop to ensure continuity and consistency. JWG members also complete the complex processes required to complete the package for hand-off to the Executive Agents. This would require that, in addition to the part-time subject matter experts, the full-time staff would have to grow to about 55 personnel (including the IM staff) for the duration of the 2.5-year requirements definition period, allowing at least two JWG members to participate in each workshop and providing adequate support for integration and management.*
- Team approach: This alternative creates standing teams for the 2.5-year period. Each team would focus on one module in each three-month period. The team members would be or become the functional experts and would obtain or provide whatever expertise was required. This alternative would require at least 90 to 100 government personnel (military and civilian) in addition to the contractor support.

Funds. Chart 2 estimates funds required to provide contractor support to complete the definition of functional requirements and to complete the software development by the Executive Agents. The estimates for the EA funding requirements was provided by the USN and USAF Executive Agents.

Pros and Cons for each Staffing Alternative.

Workshop Approach:

- Pros: Requires fewer full-time personnel assigned from Services.
Ensure maximum participation from subject matter experts.
- Cons: Provides less continuity and creates new learning curves with each node.

Team Approach:

- Pros: Provides continuity and maximizes economies of scale.
- Cons: Requires more full-time personnel assigned from Services.

*** To perform life-cycle management and coordination activities for the objective system, additional permanent staff of five will be required, for a total of 60 for 2 1/2 years, reduced to 25 thereafter.**

MILITARY PERSONNEL MANAGEMENT OBJECTIVE SYSTEM

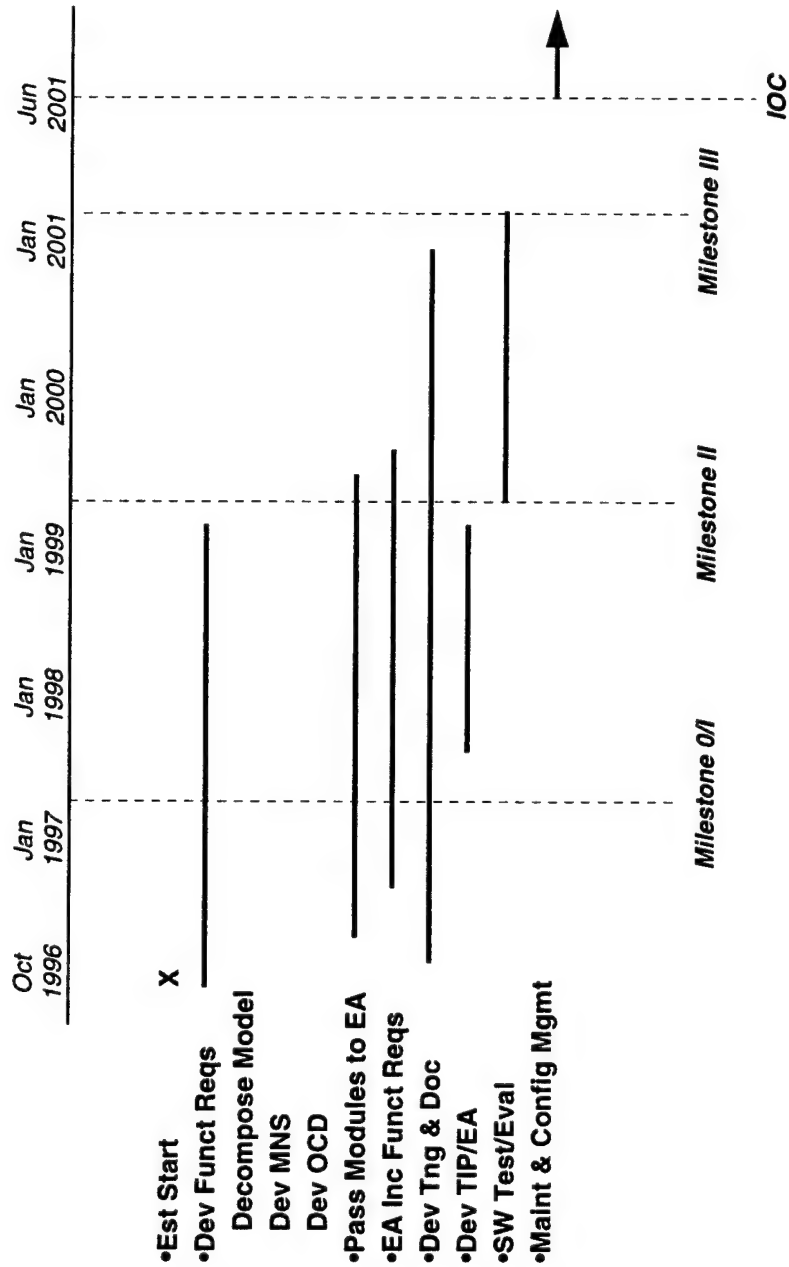


Chart 1

MILITARY PERSONNEL MANAGEMENT

OBJECTIVE SYSTEM

FUNDING REQUIREMENTS (\$000)						
	FY97 ¹	FY98 ²	FY99 ²	FY00 ²	FY01 ²	FY02 ²
<i>Funct</i>						
Reqs	\$9,360	\$9,360	\$7,400	\$6,440	\$3,480	\$1,080
EA	\$11,760	\$6,280	\$8,100	\$8,100	\$8,100	\$4,200
TOTAL	\$21,120	\$15,640	\$15,500	\$14,540	\$11,580	\$5,280
Available \$	8,000	\$13,000	\$13,000	\$ 8,000	\$ 8,000	\$ 8,000
Delta	-\$13,120	-\$2,640	-\$2,500	-\$6,540	-\$3,580	\$2,720
1 - Funding available per FY96 PBD						
2 - Funding Contingent upon approval of OUSD(P&R) POM Issue						
Estimated Program Costs			\$83,660			

Chart 2

**Using COTS Software In Systems
Development from National Research
Council of Canada, Institute for Information
Technology, Software Engineering Group
(Copyright 1996)**

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Using COTS Software in Systems Development

Using "Commercial Off-the-shelf" (COTS) software components to build systems has been proposed as a means of developing software with reduced risk and cost while increasing functionality and capability of the system. Building a system based on COTS components involves buying a set of pre-existing, proven components, building extensions to satisfy local requirements, and gluing the components together. The advantages claimed are that the COTS components are honed in the competitive marketplace resulting in increased capability, reliability, and functionality for the end user over what would be available from custom built components. COTS software components from different vendors are expected to be integrated easily, work in a wide range of environments, and support extensions and tailoring to local requirements.

The reality of the situation is quite different. Many organizations find that using COTS software carries a high risk and expense during development, during deployment, and during the ongoing evolution and maintenance of the system. Using COTS components, systems are often hard to build, to support, and to maintain. The problems encountered may be related to the processes an organization uses to build systems, in the technologies used to construct the system, and in the way systems containing COTS components evolve.

The Institute for Information Technology (IIT) is undertaking a research project to understand the problems associated with COTS software based development from the perspective of an organization that is trying to use COTS components to build systems. Given that developers from different organizations are going to continue to develop software that does not glue together easily, that may not evolve according to the users' wishes, that is continually evolving and changing, and that may not be properly supported, how should an organization go about using COTS software components for system construction? The objective of this research is to:

- Determine qualitatively the advantages and disadvantages of using COTS software in the construction of systems.
- Identify the types of systems that can benefit from the use of COTS components and the types of COTS components that can be used within these systems.
- Criteria for evaluating COTS software components.
- Modify existing software and system development processes in order to maximize the effective use of COTS software.
- Investigate technologies and architectures that enable the use of COTS software.

This research is sponsored by the Chief, Research and Development of the Department of National Defence .

COTS Software Integration: State of the art



National Research
Council Canada

Conseil national
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Institute for
Information Technology

Institut de technologie
de l'information

NRC - CNRC

COTS Software Integration: State of the art

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1. Introduction

The Software Engineering Group of the National Research Council (NRC) is currently undertaking a research project into the implications of using off-the-shelf (OTS) software to build long-lived military systems. The purpose of this project is to:

- Determine qualitatively the advantages and disadvantages of using OTS software in the construction of systems.
- Identify the types of systems that can benefit from the use of OTS components and the types of OTS components that can be used within these systems.
- Develop criteria for evaluating OTS components.
- Identify problems with the existing software and system development and procurement process that inhibit the effective use of OTS software.
- Investigate technologies and architectures that enable the use of OTS software.

This paper presents some initial results and observations regarding the OTS software usage. These results are based on the following activities:

- A series of interviews was conducted with personnel within DND who are involved in procuring or maintaining systems that contain off-the-shelf components.
- Round table discussions and interviews with researchers and commercial software developers who are interested in component based software.
- Review of the literature to determine the current state of the practice and current state of the research in building systems from OTS components, building software components, and open standards that enable the use of off-the-shelf software.
- Experimentation with different technologies and standards that are designed to enable the use of off-the-shelf components.

2. Characteristics of off-the-shelf based system development

Building systems from off-the-shelf software components is an instance of a type of software re-use. It differs from other forms of re-use in that the system developer buys the components (usually without the source) from third

developers and then integrates the components into the system. Characteristics of this approach to system development include:

- A component software product is designed to be sold in many copies to multiple customers with minimal changes.
- Pre-existence is one virtue - not only because it can shorten delivery schedules but because it means the customer can use pilot studies to rethink "requirements" and to investigate deployment problems.
- Honing in the marketplace, especially a competitive marketplace, improves specification, design, and implementation in ways that a waterfall development cannot anticipate.
- Vendor is responsible for ongoing support and maintenance - but this implies customer must accept upgrades
- No single customer has control over specification, schedule, or evolution.
- The specialized nature of the OTS product allows the customer indirect use of the rare skills of designers and implementers.
- Access to source code is unusual.
- The development process used may not be your favorite nor appropriate for easy configuration management and control.
- Internal documentation may be non-existent or not accessible.
- Technical information, especially as to limitations, performance, or resource consumption, may never have been collected.
- User level documentation, customer documentation, and training may be well developed.
- Depending on the source of the components, they are referred to as Commercial off-the-shelf (COTS), Military off-the-shelf (MOTS), Government off-the-shelf (GOTS), etc.

3. Off-the-shelf components: state of the art

As part of this research we have talked to numerous military, government, academic, and industrial people involved in the development of COTS components, or building systems from COTS components, and surveyed the literature to identify problems other organizations had had when building systems from COTS components [BRO95,NAS95]. The purpose of this survey was to understand the current practices of DND in terms of COTS software, determine the experiences and attitude of those responsible for software systems, and to learn what kinds of problems (and solutions) people had experienced in relation to COTS software integration.

Within DND we surveyed eleven different groups or organizations and eighteen different individuals involved in about fifteen projects. The projects were primarily Command and Control systems or information systems.

There was no attempt to gather quantitative data. Very few useful metrics were available and it is unlikely that these would have any relevance across different projects. Thus the data gathered is qualitative and anecdotal.

3.1 Current practices

Within DND all the systems looked at as part of this study were either information systems or command and control systems. We did not look at weapons systems but are aware of a number of systems that use OTS software, particularly where it is embedded within specialized OTS hardware.

There are different ways of using off-the-shelf software. The primary approaches we found within DND are the following:

- **Buy and adapt.** The buy-and-adapt model is characterized by acquiring a single complete working system that satisfies most of the requirements of the acquisition agency and adapting and extending it for local needs. The adaptation of the system is done by extending it through add-ons, interfacing with other applications, or modifying the off-the-shelf application through source code changes (But then is it really "off-the-shelf"?)
- **Component integration.** The component integration model of software development builds software systems by integrating a number of off-the-shelf components where each component satisfies some of the requirements of the system. This model usually depends on the use of some "gluing technology", which may be unrelated to the components, to provide an interface between components.

3. 1. 1 Buy-and-adapt System

The buy-and-adapt model of OTS reuse builds systems by purchasing an application which satisfies most of the system requirements and then extending and tailoring the application to satisfy local requirements. This model of development was used for both command and control and information systems. The applications bought were both military off-the-shelf (MOTS) and commercial off-the-shelf (COTS).

Within DND we observed two methods for modifying and extending systems:

- **API's.** Most of the systems which were bought and adapted had some kind of an API. The developer can write a controlling program that calls the COTS component API as required. Typically this involves writing a "wrapper" around the OTS component to isolate the workarounds and extensions and provide a somewhat higher level of abstraction to the component's interface. The developer then writes the main program that controls the sequence of execution including calls to the OTS component (Figure 1a).
- **Modifying source.** If an OTS system does not satisfy all requirements then the supplier (or a contractor with access to the source code) can modify the

application to satisfy the local requirements. However, once modifications to the source code is done the acquisition agency no longer has an off-the-shelf component but rather has a one-of-a-kind system. Using this approach there is a risk that these changes will become orphaned and the vendor will not support them during the normal course of upgrading the product.

The problems we have seen with systems that have been bought and adapted are:

- Limited source of supply. One argument for using COTS is that competition between vendors will drive prices down and improve quality of the systems. For many MOTS software applications there is limited choice of systems for purchase with minimal ongoing competition and these arguments do not apply.
- New releases of OTS component. Replacing older versions of COTS software with newer releases is difficult. New requirements or new hardware may preclude continued usage of the older version. Extensions and modifications made to the previous version must be re-integrated into the newer system. We saw three approaches to this problem:
- Assume (hope?) the API and data formats of the new releases will not change significantly.
- If extensions are added to the OTS software, have the vendor certify the changes as being compatible with all future releases.
- If modifications have been made to the original source code, contract with the original developer (or someone with access rights to source) to make modifications to new releases. There is potentially a high risk (and high expense) associated with this approach: a complete process of analysis, development, documentation, and testing must be performed for the one instance of the product.

Within the commercial world the use of API's and source code modification are used but there is also a large amount of interest in using a concept known as frameworks . A framework is a large scale component or an application which is designed to be extensible and integrated with other frameworks. With a framework one is not buying a component called through an API, but rather an implemented architecture inside of which one can embed extensions using techniques such as plug-ins and inheritance. The difference between traditional API based components and frameworks is shown graphically in Figure 1. In the traditional model (Figure 1a) the custom code defines the architecture and the COTS component is embedded in and called by the custom code; in frameworks

(Figure 1b), localizations and extensions are embedded inside the framework, use the framework's architecture, and are called by the framework.

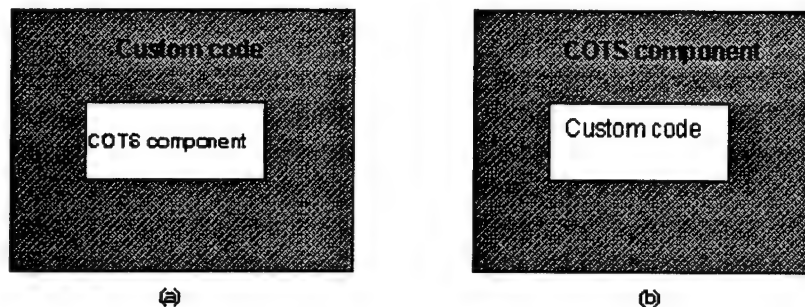


Figure 1.
(a) Traditional model: COTS embedded inside custom code.
(b) Custom code embedded inside COTS.

Frameworks can be constructed to provide generic services (such as the OpenDoc framework which provides an open architecture) or they can provide services within a specialized application domain, such as to the financial services industry, manufacturing, health services, etc.

A framework can be tailored and extended in a number of ways:

- **Plug-ins.** Developers can add functionality to an application by writing a "plug-in". A plug-in notifies the framework of its capabilities and services and the framework calls the plug-in as required. Effectively this reverses the traditional role of a component and the custom code: rather than the custom code calling the component through an API, the framework calls the custom code that is implemented as a plug-in.
- **Scripting.** A script is an executable fragment of code which is dynamically linked to components of the system. A script can be used to extend the behaviour of a component (by having the component execute the script), or it can be used as a coordination mechanism to integrate two or more components (by providing the "glue" for linking the components together). Over the last few years, numerous languages designed specifically as scripting languages have been developed and are being used on a commercial basis (e.g., ObjectREXX, Visual Basic, AppleScript, JavaScript, tcl, Perl, Python, etc.) Currently there are two rival scripting architectures which are competing for market dominance: the Open Scripting Architecture (OSA) which is supported by IBM, Apple, and most of the computer manufacturers; and OLE Automation which is supported by Microsoft.
- **Inheritance.** Inheritance allows specific parts within a component to be specialized and modified. Current object-oriented standards allow inheritance to be used by developers who only have access to executable

binaries and not to the source code. In contrast to scripting, which is often done by end-users or their support staff, inheritance requires a deep knowledge of the architecture of the framework and would normally be applied only by professional developers. Examples of this approach can be found in the CORBA object model and DSOM from IBM.

Within the commercial world building systems from frameworks can be viewed as a "just-in-time" programming model where components move along an assembly line from the developer through the integrator to the end user, and functionality is added at the latest possible point along this line. Component developers build large-scale components that provide services that appeal to a large market; integrators extend and combine the components to build systems; and end users and their support staff tailor the system for local needs.

Although frameworks are being developed (or at least talked about) within many commercial application domains there is currently limited activity in the military domain. There is an initiative at DoD's ESC Software Center (described in [BRO95]) which is being developed along the line of frameworks. The objective is to define a set of product lines each with its own evolving architecture and continuing qualifying COTS products. A client approaching ESC for a solution will be sold one of these standard architectures tailored to the clients needs. By this means they intend to have the capability to deliver systems to their clients quickly and with very little development effort. The price they pay for the short delivery time and low cost is that they do not expect to be able to satisfy 100% of their clients requirements, but they do expect to satisfy enough of the requirements that they are considered a cost effective solution.

Another example of a framework based approach is the DIGEST GIS system being developed at DREV. The GIS system is the framework to which plug-ins can be added to extend functionality. The objective is for development of both the GIS framework and the plug-ins to be taken over by commercial developers.

3. 1. 2 Integrating components

The integration approach to COTS usage involves the developer buying two or more separate COTS software packages and integrating them into a larger system.

A component to be integrated can be packaged in many different ways. Within the systems we studied we observed the following component types:

- **Procedural libraries.** Component is delivered as a set of library routines which are linked in at build time.
- **Legacy applications.** Application is part of an organizations structure and workflow and must be included as a component within the new system.

- Off-the-shelf applications. Component is delivered as a stand-alone application (which may or may not have open interfaces and data formats.) Integration can take different forms, such as API calls, shared data in standard formats, "screen-scraping", event passing, drag-and-drop, etc. The most common form of integration observed was the use of shared databases and shared files.
- Tools. Tools are a mechanism to automatically build source code. An example is a GUI builder. Tools typically work by having the developer describe the system using the tool's language. The tool then generates source code that can be compiled and linked with the other components of the system.
- System services. Operating Systems, databases, windowing systems, and device drivers are typically purchased today as COTS components, and perhaps even considered part of the hardware platform on which the system is to be built.

In addition to the above component package types, there are others ways of packaging components. Two of interest are the following:

- Frameworks as defined in the previous section.
- OLE Components. The OLE standard from Microsoft promotes a number of technologies which are intended to enable reusable components. These include OLE Custom Components (OCXs) and OLE Automation servers. At DREV there was a project being undertaken to package a GIS system as a set of OLE component which can be extended through plug-ins from commercial developers.

The successful uses of COTS components which we observed within DND were the following:

- GIS. Numerous GIS libraries exist and provide adequate functionality for many applications.
- GUI builders. GUI builders are tools which are becoming mature and indispensable.
- Office automation software. Software such as calendars, word processors, and spreadsheets are used within many systems. The interaction between these applications and other components of the system were done primarily through desktop features such as drag-and-drop and enclosing files within e-mail messages.
- E-mail and messaging systems.
- Databases. Databases are an accepted part of many systems and are almost always bought off-the-shelf.

- Operating systems, including low-level software such as device drivers, windowing systems, etc.

The above list is made up of applications and components which are mature and pervasive in a large number of systems. This maturity is a likely reason why they have been successfully marketed as COTS software components.

Outside of the mature areas listed above, project and maintenance managers were generally skeptical about the feasibility and benefits of using COTS components to construct systems. Applications were not generally designed for interworking together, the applications required extensive wrapping, and large amounts of functionality needed to be added to the applications. In the small number of examples where we found COTS applications outside the above domains being integrated, the attitude of the managers was that the exercise could not be considered entirely successful. This was due primarily to problems in integrating and extending the functionality of stand-alone applications that were not designed to be integrated.

The current mechanisms we observed for integrating COTS components were the following:

- Procedure calls. The COTS component is accessed by linking to a procedural interface. Examples include components that are packaged as a procedural library, applications with an API, and databases with an SQL interface.
- Desktop supported capabilities. Desktops provide limited capabilities for integrating components through features such as drag-and-drop, clipboards, cut-and-paste, etc. This is generally how office automation software was integrated.
- Data sharing. For applications that store data in a standard format integration can be accomplished by having components read and write each others data. The shared data can be stored in shared files or in a shared database.

Problems we observed with the integrating COTS components include:

- Stability and support from suppliers was lacking.
- Integrating new releases of COTS software was a labour intensive and error-prone task.
- Contractors were sometimes unfamiliar with COTS product.

4. Experiments with Open Scripting Architecture (OSA)

Traditionally, commercial software packages have been bought and used on an "as is" basis. Commercial applications are sold as executable packages that have limited functionality for adding new services to the application. Users have

been able to install the packages and, except for some minor tailoring, have had to accept the existing functionality of the software application.

Recently, there has been an initiative to open up software applications to allow users and third party developers to extend the functionality of applications and to integrate applications from different vendors to provide more sophisticated services to users. This trend has led to a number of competing and complementary technologies which are intended to allow developers to package open and extensible applications which can be enhanced and integrated by users and third parties.

As part of the research project, we are experimenting with emerging technologies that enable the use of COTS software components. One set of experiments we conducted was to take commercial off-the-shelf applications and to extend their capabilities using the Open Scripting Architecture (OSA). The purpose of this experiment was to determine, from a user's perspective, how effective the OSA currently is for extending application functionality.

The Open Scripting Architecture (OSA) is one of the two scripting architectures competing within the marketplace (the other being OLE automation). OSA is currently under control of the CIL consortium. It was originally developed by Apple Computer and is an integral part of their System 7.5 operating system. OLE automation is part of the OLE standard from Microsoft.

OSA has been adopted as the scripting standard for OpenDoc and thus will be available on most platforms. Currently, OpenDoc, including OSA, has been released for Macintosh System 7, Windows, and OS/2. The architecture is not dependent on a single scripting language. Thus on the Macintosh platform, OSA scripts can be developed in AppleScript, or with some difficulty, Usertalk or tcl. Under OS/2, OSA scripts can be developed in ObjectREXX.

Scripting architectures are designed to allow developers close to the end users (and end users themselves) to integrate and extend applications. They are designed primarily for integrating and tailoring applications rather than for major development work. Applications built according to the OSA standard can extend their behaviour by executing scripts, and can communicate with other elements of the system by exchanging events.

Among the lessons we learned from these experiments are the following:

- Determining behaviour of COTS software components is difficult. Documentation, no matter how well done, is insufficient for understanding the detailed behaviour of components. Other than reading the documentation, other techniques we used for exploring component behaviour included:

- **Experimentation.** Understanding the characteristics of a component always required experimentation. The OSA provides a means for CASE tool developers to build environments for experimenting with component behaviour.
- **Examples.** Most of the COTS components we integrated had a large user base. Examples and workarounds built up by this user base were invaluable for solving many problems we encountered. This reflects our experience with many popular commercial applications where a large degree of support for the application comes from the user base rather than from the supplier.
- **Browsers.** The OSA defines a means by which applications can advertise their objects, data structures, etc. Good browsers help a developer in categorizing and locating relevant information in an applications interface.
- **Recordability.** OSA defines a capability whereby events can be recorded and disassembled into an appropriate high-level language. By recording an applications behaviour and studying the program fragment generated we were able to learn about the characteristics of some applications.
- **Extending the OSA architecture leads to conflicts between the extensions.** The OSA defines a means of adding extensions to the scripting language. Many of these extensions are being developed and marketed by third parties. Unfortunately, with the large number of extensions being developed naming conflicts are arising between the extensions.
- **Performance is low.** The OSA architecture is currently not viable for time-critical applications.
- **Concurrency is not supported.**

5. Related work

There are a number of initiatives being undertaken by different organizations on using COTS software components. This section lists some of the initiatives which are relevant.

The Software Engineering Institute (SEI) has initiated a project to research the implications of using COTS software to build military systems. Their research has focused on two initiatives: a laboratory project to investigate the integration of COTS CASE tools [ZAR94]; and a two day workshop on the use of COTS in system integration [BRO95]. The workshop proceedings are particularly interesting having brought together industrial and military people to talk about COTS integration within the following frameworks: technical;

commercial/business; system architecture; open systems; and acquisition regulations. The workshop identified current problems and future directions of research in COTS integration.

NASA is a strong advocate COTS software and has a number of workshops and initiatives in this area. Their main focus has been on cost and risk reduction through reuse of software components across different projects. Most of their published data has focused on the acquisition/development process needed to foster use of COTS components. They identify a number of successful examples of COTS component usage. In addition to the more common COTS applications of database and user interface tools, they provide other examples such as a mission that integrates three different COTS applications: telemetry and command processing, orbit prediction, and health and safety monitoring [NAS95].

Among the lessons they have learned on successful usage of COTS are the following [NAS95]:

"The following beliefs about COTS packages are questionable

- COTS package solutions are less risky
- I can buy and modify a COTS package more quickly than I can develop it
- There is a COTS package for my application
- The COTS package works because there are a lot of copies in a lot of other organizations
- The vendor will keep the COTS package current.
- Vendor literature is true.

The following beliefs are reality:

- Vendors over commit themselves
- Vendors don't supply all services
- The software may not meet the requirements.
- The software may not be easily modified.
- I have very little control over vendor quality and schedule.
- My organization may have to change to accommodate this COTS package.
- Support costs for modifications may be 20% of the cost of the modification per year

Some fundamental differences between COTS based development and custom development are:

- COTS based development may need infrastructure earlier to demonstrate and prove the COTS package
- The COTS package may dictate standards, architecture, and design
- The COTS package may influence work flow

- Picking the wrong COTS package may be more expensive than fixing problems in custom software
- Issue resolution processes need to be in place earlier to resolve COTS package issues
- Issue resolution processes may be more complicated because of the addition of the vendor and possible incompatibilities between the vendor's practices and yours."

A number of new standards are being developed, driven primarily by commercial interests, with the goal of making component based software development a reality. The standards of interest include:

- The CORBA standard [OMG95] from OMG (<http://www.omg.org/>). The OMG, through CORBA, is standardizing an object-oriented approach to re-usable components. The CORBA standard is done at three levels:
 - CORBA which standardizes how component interfaces are specified and method invocations.
 - CORBA services which standardizes services which are common across many applications. Examples of services include security, object life cycle, transaction processing, etc.
 - CORBA facilities which standardizes frameworks (i.e., reusable components) within a specific application domain, e.g., manufacturing, financial services, etc.

The CORBA and CORBA services have been standardized by the OMG. CORBA facilities are being standardized by interest groups within OMG but the standards are not yet in place. Although CORBA compliant Object Request Brokers (ORBs) are available commercially, a market has not yet developed for components built to this standard.

- The Component Object Model (COM) from Microsoft. This provides similar functionality to the CORBA standard (but not CORBA services nor CORBA facilities.) The COM is an implemented standard to which components are being built. It is limited by the fact that in its current form it does not support distribution and works only under Microsoft Windows.
- The document and desktop level component standards of OLE (from Microsoft) and OpenDoc (from CIL). OLE and OpenDoc are currently implemented on a limited number of platforms.

6. Issues with COTS software integration

This section identifies and discusses a number of issues related to building systems from COTS components. The issues discussed are:

- Procurement/development process
- Understanding and evaluating components
- Evolution of software
- Architectural issues Role of standards

- Embedded systems

6.1 Procurement/development process

A number of participants commented that one of the key elements to successful use of off-the-shelf software is that to gain the benefits while minimizing the risk an organization must be willing to accept the software component as-is with minimal changes. If the organization is not willing to accept the capabilities and limitations of the software as they exist then many of the benefits of off-the-shelf software will not be realized. This conclusion has been reached not only by ourselves, but by a number of other organizations which have researched the use of OTS software. The Auditor General of Canada which audited a number of large-scale government systems development projects made the following comment while auditing a Transport Canada system that is heavily dependent on COTS software:

"While the acquisition and installation of a commercially available software package should have been the least complex of the systems reviewed, the extensive modification of the software ... significantly increased the project complexity. As well as adding complexity, such modification may make the implementation of new releases of the software more difficult and costly.... A significant portion of the savings come from limiting the extent of changes to the commercial software package." [AUD95]

Therefore, in order to realize the benefits of COTS software a procurement process must be in place that defines requirements according to what is available in the marketplace, and that is flexible enough to accept COTS solutions when they are proposed.

The issue of impediments to using OTS software in military/government procurements is addressed by NASA [NAS95] and widely discussed in the SEI workshop [BRO95]. Both organizations have emphasized the need to accept the capabilities and limitations of OTS software and to adapt operational requirements to the availability of the COTS components. Currently, rather than approaching procurement with the attitude "what exists off-the-shelf and how can I use it", the procurement process identifies strict requirements which either excludes the use of COTS components, or requires large modifications to COTS packages in order to satisfy the requirements.

"In the old process, system requirements drove capabilities. In the new process, capabilities will drive system requirements...it is not a requirement if you can't afford it"

A number of the procurement issues brought up by SEI workshop include:

- Overly specific requirements often preclude the use of COTS components.
- Use of MIL-SPECs preclude the use of COTS.

- Different development standards are needed for development based on COTS software.
- Allow contractors to submit alternative proposals which may violate some stipulations of the solicitation but may be technically superior due to the use of COTS.

New military standards and procedures [MIL498] recognize the need for developers to include consideration of COTS components during the development process. Paragraph 4.2.3 and Appendix B of the 498 standard provide specific guidelines for incorporating 'reusable software products' into software systems. These guidelines make it clear that unmodified COTS must be handled differently than modified COTS. In general, the standard requires that modified COTS be treated as if it were normal developmental software. This means that it must be fully documented and tested within the scope of the new system. Much of the standalone testing and documentation requirements have been eliminated for unmodified COTS. In this case the standard provides for the use of existing documentation and a proven performance record as verification of the COTS software.

6.2 Understanding and evaluating components

A component which is worth buying is likely a complex piece of software. In order to use such a component effectively it is necessary to understand it at quite a deep level. Understanding the behaviour of complex components is an extremely difficult task for a number of reasons:

- The documentation is incomplete or wrong. Even if the OTS supplier is conscientious about documentation, a complex piece of software will not be fully and correctly documented. Even incomplete documentation may be so massive as to be incomprehensible to any but the most experienced users.
- The interface may be very complex. Many of the standard components being marketed (e.g., OLE, DCE) have APIs with hundreds of calls. Not even the people working on these systems know how each API call behaves or the effect of particular sequences of calls.
- There are bugs in the software.

There is no easy solution to understanding complex systems. Documentation must be available and used, but a deep understanding can only be gained through extensive experimentation. Trying to understand these components has been called "an experimental science without any laws of physics." One advantage of using a COTS application with a large user base is that much of the experimentation has been carried out and the knowledge is available in the user community.

Many of the problems encountered with integrating COTS components cannot be determined before integration begins. The problems are of such a nature that they only appear well into the integration process [GAR95]. This makes estimation of schedules and resource requirements extremely difficult where COTS components are used. Extensive evaluation of the COTS component will be required to ensure not only that the component has the functionality to perform the required tasks within the system, but also that the additional functionality inherent within the component does not interfere with the system. The cost estimates must take this evaluation process into account.

6.3 Evolution of software

Systems are constantly changing; COTS components within systems are constantly changing. This evolution of systems and their components has an impact in a number of ways on the maintenance of systems.

All people we interviewed stated that there was a large amount of work required to integrate new releases of COTS software into their systems. For a system constructed from multiple COTS components, with each component having its own release schedule, the cost of integrating each new release of each component becomes prohibitive.

The difficulties arise for two reasons:

- In the new release of the COTS component there will likely be changes in the behaviour, interface, assumptions, performance, bug fixes etc.
- Specializations, extensions, and workarounds made to the older version of the COTS component which must be integrated into the new component. There is no concept of "compliance" as in mechanical systems where parts are not defined to fit exactly but rather within certain tolerances.

One approach to the problem of evolution is to assume that the system (or at least the COTS component within the system) will never be updated. This will not be practical in all cases. The software may be dependent on a particular platform that is no longer available or is being updated; operational requirements may change; or bug fixes in the new releases may be required.

Integrating a new release of COTS software requires a significant development effort. First, the new release of the COTS software must be evaluated to determine what has changed from the previous release. Second, the new component must be integrated into the system. This may involve adding or removing workarounds, adding new extensions to take account of new behaviour, updating documentation and training procedures, etc. Finally, the system must be tested and verified.

6.4 Architectural issues

An appropriate software architecture addresses three issues related to the use of COTS software components:

- Plug-and-play of components. An architecture should allow pre-built components to be quickly assembled into larger systems. Components should be replaceable with a minimum amount of effort.
- Sharing of components/knowledge across projects. Within DND, many projects are implemented using a "stovepipe" model where each project develops components through all layers of the system with very little re-use or sharing with other projects. Many projects within DND have similar functionality and requirements; an appropriate architecture would encourage sharing of components across projects to take advantage of this shared functionality.
- Building systems as components for larger systems. All systems built should assume that one day they will be the off-the-shelf component which will be integrated into a larger system. Systems currently being built within DND have limited capability to be integrated into other systems. While this is a highly desirable trait, it is obvious that commercial vendors will be reluctant to add increased complexity to their product (at increased development cost) to provide interworking with other systems unless it can be shown that there will be a return on investment. If we assume that DND cannot effectively influence commercial vendors, then the viewpoint should shift to ensuring that the COTS "glue" is flexible enough to accommodate integration with future systems.

6.5 Role of standards

There is clearly a role for standards in enabling the use of COTS software for building systems. If standards are defined correctly and if software developers build components which comply with the standards then this goes a long way towards making open systems a reality. There are already a large number of standards which have had an impact in building plug compatible software components. Examples of these include tcp/ip, Xwindows, and SQL. There are many other standards in many other domains that have the potential to have a similar impact. Some of these address directly the issue of interoperable components (e.g., OLE, CORBA, ODP, OpenDoc, etc.) while others are targeted at a specific functional domain.

Although standards are important it must be recognized that there are many problems that standards do not address. For example, regardless of how pervasive standards become, they do not in any way eliminate the need for evaluating and experimenting with COTS components or solve the problems associated with maintenance and evolution of systems containing COTS components.

Another issue that must be recognized by DND is that to gain the benefits of standards it must be willing to accept the de facto standards which have gained acceptance in the marketplace. DND does not have the market force to dictate standards and attempts to mandate standards will likely lead to the use of software that is not widely supported in the commercial world. The role of DND should be to monitor and understand the standards, and possibly to try and influence the standards definition process, but once a standard has been accepted in the commercial world, be it a de jure or a de facto standard, this standard must be accepted as is by DND.

6.6 Embedded systems

Although using COTS components is usually associated with information systems there are instances where COTS components can be effectively applied to real-time and embedded systems. There are many examples of real-time systems which make some use of COTS components. At the SEI workshop, the claim was made that the Boeing 777 has 4 million lines of COTS software including Microsoft products. (It was also claimed that to Bill Gates, Boeing was too small a customer to meet with.)²

Areas where COTS software components do have impact on embedded systems include the following:

- Embedded software. When buying a specialized piece of COTS hardware there will almost always be software embedded in the equipment.
- Specialized expertise. If embedded systems require access to highly specialized expertise, this expertise may be more readily provided by COTS software rather than attempting to hire the appropriate experts.
- Operating systems, etc. Embedded systems will generally use commercial operating systems.
- Standard non-critical components. Many embedded systems will continue to contain standard components that can be bought off-the-shelf and integrated. These include for example report generators, GUIs, databases, etc.

Issues to be resolved include:

- Certifying components that are critical. If a COTS component is to be embedded in a critical system, a rigorous certification process must be performed on the component.
- Constructing firewalls between the critical system and uncertified COTS components.

^{1 2} Stated by Claude M. Del Fosse, SPC, in [BRO95]

7. Future research

Possible future directions of research relating to COTS software integration include the following:

- Develop techniques for evaluating and experimenting with COTS components. Select a number of products and attempt to define or develop tools which could be applied to a COTS component to pre-determine the overall functionality of the component. This may lead to the definition of a classification system which would allow project groups to quickly create short-lists of appropriate software components for their particular system. Another approach could be to attempt to analyze and establish evaluation criteria to be used to determine the suitability of a COTS component within the framework of a specific system.

Define and evaluate technologies and architectures that promote reuse across projects and allow applications to be integrated into larger systems. Issues which could be investigated include:

- Coordination languages designed specifically for integrating and extending COTS applications.
- Component architectures, including scripting architectures and frameworks.
- Architectures which facilitate component reuse across projects.
- Experimentation and monitoring of standards (CORBA, OLE, etc. ...). Experimentation is required to fully understand the functionality of these standards and determine how they may (or may not) facilitate the use of COTS software.

Develop a guidebook for project and maintenance managers that identifies issues associated with COTS development. Contents of the guidebook could include:

- Overview of development process applicable when integrating COTS components.
- Costs, benefits, and risks associated with COTS software reuse.
- Lessons learned from previous experiences with COTS components.
- Tools and techniques for integrating components.

- Pick an application domain within DND and determine how current state-of-the-art commercial software satisfies the needs of DND and how DND might change its systems to take advantage of COTS within this domain.

1/25/96

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**“Retool Human Resources” and “HR App
Meets Critical Needs” articles from
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RETOOL HUMAN RESOURCES

You bet payroll counts. Back-office human resource processing, too. But the real reason to go to a client/server HRMS system is to give line managers the power they need.

By Lee The

In lots of companies, "People are often treated worse than the equipment," says Bob Snelling Jr., senior VP of IS at Snelling International, a temp employment placement agency in Dallas. "They deserve to be treated with more respect." A good client/server HRMS suite can help companies do this. Too touchy-feely a reason? No. It makes good business sense--and it's the right thing to do. The most concrete way to show respect isn't commemorating birthdays in the company newsletter but by letting people manage their own resources. Client/server HR systems could allow employees to get information about benefits or change personal data (new address, marital status, withholding, and the like). Managers can use those systems to do employee reviews or initiate hiring and disciplinary processes (all automatically routed to the right sign-offs). In short, client/server HRMSs can distribute human resource functions out to the line managers and to individual employees. And, just in case you hadn't noticed, enterprises are getting squished. The winds of change have blown away layers of the hierarchy that used to provide the rungs on a career ladder. Employee evaluation, compensation, and career-planning issues have gotten much more complex and need to be administered much closer to the involved employees. All this doesn't just encourage client/server HRMS. It mandates it.

RETOOL HR AND THE COMPANY

Jim Holincheck, a Chicago-based manager in Andersen Consulting's software intelligence group, says many of his clients are using HR systems to retool their workforce and shift to performance management. That shift includes everything from building appropriate skills in the workforce to compensating appropriately in the market.

You'll need to be able to tie into your skills database to see what has been planned and completed. This is one place where workflow comes in. Dun & Bradstreet has built proprietary workflow functionality into all of its products, including human resources. D&B is the clear leader here. Its HR Stream is fully integrated with D&B apps, so it sends around the actual transaction or piece of work, not just a message or form. SAP and Ramco say they will offer equally embedded workflow starting late this year. Also check out Edify. A number of vendors use Edify's workflow automation products in conjunction with Lotus Notes to help define workflows for certain processes.

Tied to workflow is the fact that enterprise solutions are about providing the right information to the right people, regardless of departmental boundaries. Therefore, your HR system needs to be able to work across boundaries. Dowdy image notwithstanding, HR has been at the forefront of a lot of avant-garde technology, including scanning, imaging, information kiosks, and voice response. "We're seeing a lot of

innovation in HR because it can help flow to the top line," Holincheck says. Clerical pencil pushing is being replaced by table-driven packages tightly integrated with payroll. "So, when changes are made to benefits elections, the payrolls are automatically adjusted. " Bottom Line THINK LOOOOOOONG TERM

The HR system you buy needs to be more than client/server. It needs to be far more than an automated back-office HR clerk and paymaster. It must be able to reflect any and all organizational changes that your company may go through over the next decade. It needs an open architecture so you can incorporate voice response, telephony, and other new hardware/software technologies as needed. And the vendor needs to show a high level of consciousness about such trends.

Look for the ability to extend applications without disturbing the core functionality, and then couple that with sophisticated upgrade management. You need to be able to locate processing at the most logical place relative to performance and security. Object-oriented architecture best supports this, though few products are coded this way yet. Traditional HR/payroll packages are long on record keeping and short on reporting, so strong query and reporting tools are a must. And note whether those reports and queries can go against the operational data without needing a warehouse. You may see your HR department getting distributed; regional people may handle local data entry, recruitment support, and other tasks while headquarters does payroll and pension administration. Make sure your HRMS supports such application distribution.

One zone of contention common to all client/server products is database support. Vendors like D&B, Humanic Design, and Oracle currently support just one database. Oracle HRMS (not surprisingly) only supports Oracle. The same is true for Humanic Design's Empire/SQL. D&B's HR Stream only supports Sybase. Others, like PeopleSoft HRMS, support several databases but forgo stored procedures and triggers and other deep-level implementations. This is a tough call, with advantages both ways. D&B is working on adding Oracle support, but it seems to be taking forever to do the port. Integral claims that its ground-up HR line rewrite, due this fall, supports Informix, Oracle, Sybase, stored procedures, triggers, and all. Deep database support is most necessary for OLTP, so even if you lean that way in other areas it's probably not as crucial with HR. Ramco, which calls itself a Microsoft shop, does its database access through ODBC. Holincheck has this tip: Payroll is the most likely bottleneck. If you're unsure whether or not payroll will fit within your batch window, give the vendor 60 days to benchmark payroll in house before you sign on the dotted line.

Frequent on-line operations do loom large in HR's future, starting with on-line time entry for employees. This can be sent by e-mail or modem to a central-processing operation, with links to attendance-monitoring and perhaps more general project management and labor allocation modules. There could be automatic feeds into payroll and even the general ledger. That way, the financials can use the hours reported, multiplied by standard rates, to get a cut at costs right away. Then they get trued up to payroll later.

Customizability is going to be key now and in the future. The trouble is, some vendors rely on proprietary toolsets. SAP's ABAP 4GL is more arcane than PeopleSoft's PeopleTools. D&B, Humanic Design, and Oracle use general-purpose development tools, which your shop may know already. But don't let that keep you from looking at PeopleTools to see what application-specific functionality can do for you. Whoever makes the tools, make sure the vendor shares your goals. If you want to implement workflow and the vendor doesn't, you may be out of luck. Also, vendor perceptions of how much you'll need to use a toolset vary. Oracle claims to deliver 90% complete HR apps, whereas PeopleSoft expects you to customize a lot more.

One good way to determine which products fit your needs-or how much customizing you'll need to do to make them fit-is to put them through a specific business scenario. One scenario Andersen's Holincheck has used starts with identifying an open position. Next, you search for internal and external candidates on file, place an ad in a number of newspapers, capture the cost, and tie it back to the requisition. Then, you scan in r, sum, s sent in response, and OCR them. You schedule interviews, record results, automatically generate an offer letter, scan in the acceptance letter, then at the point of hire transfer all germane data to the employee record. This is a common process. The trick is to see how well it works and how easily it flows from one stage to the next.

Long-time HR software vendors haven't all embraced the move out of that cozy little HR office, so a mainframe HR background is no guarantee that the vendor knows what's happening today. Likewise, some financials vendors have added HR products mainly to round out their product lines. In that case, you'd better find out just how well the vendor supports its HR line, from dedicated developers to in-house consultants.

Look closely at how much integration you really need between HR/payroll and financials. Being able to get it all from one vendor offers obvious advantages, but they're not as great as they might be from integrating other areas of the business.

PARTS AND PROMISES

Just a year ago, it would have been simple to talk about client/server integrated human resource products for the enterprise. PeopleSoft was shipping a full suite. Everyone else had parts and promises. The vendors that have done the best job of playing catch-up include Cyborg, Dun & Bradstreet, Genesys, Integral, Lawson Software, Ross Systems, Personal Data Systems, and Software 2000. D&B, Lawson, and Ross are best known as financials vendors. The others have been in the HR business for years, but not all of them have completed their client/server lines yet. Integral is missing a payroll module, and D&B is missing both payroll and benefits. JD Edwards has spent the last two years rewriting its in-house CASE tool, and the first products will ship later this year.

As the saying goes, "There's many a slip 'twixt the cup and the lip." That certainly applies to the challenge of converting from legacy to client/server apps, because there's often a world of difference between what some vendors say is possible and what really is

possible. D&B, for example, provides a product that does the actual data conversion and claims it reduces conversion time by 70%. D&B also has a coexistence strategy so you can, say, run legacy payroll on the mainframe and tie it in with client/server HR. ADP even lets you tie its C/S HRMS to either a service bureau payroll system or an in-house one. And JD Edwards' new product line (code named "One World") will let you start out host-centric on your current hardware and operating system, then move to full distributed client/server processing incrementally.

Illustration by Daniel Pelavin

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HR APP MEETS CRITICAL NEEDS

When Snelling International went looking for a client/server HRMS package, it asked vendors to jump through a flaming hoop so hot only one package could handle it.

By Lee The

Snelling International's mission-critical application is--no fooling--its human resource management system. That's because SI's core business is hiring and deploying a huge, constantly shifting workforce of temp workers. Few companies wring out their HRMS software like SI does. Yet despite having needs specific to the employment agency business, SI discovered that its ideal HR package didn't come from the vertical market software providers. To get what it needed, SI had to turn to a broad-spectrum HR package.

To be fair, vertical HR packages for employment agencies are designed for companies that are smaller than SI. From its Dallas headquarters, SI operates through 251 franchise and company-owned offices spread across five countries. Last year, it processed over 50,000 W-2s and 338,000 paychecks, and sent reports to about a thousand local, state, and national regulatory agencies.

SI's HRMS needs go way beyond the back-office complexities of administering a kaleidoscope of rotating jobs, employers, locations, industries, government regulations, and people. The boom in downsizing has spawned a concomitant boom in the demand for temporary and contract workers. Even when companies are looking for permanent employees, they are turning to "try before you buy" contracts, which let employers hire SI temps after 13 weeks.

Demand has outstripped supply. Thirty-thousand-odd placement agencies (several dozen of which operate on SI's scale) fight over good temp workers of every stripe. SI has been growing 30% a year, rising to \$300 million in revenue last year, but to maintain that growth in the face of such fierce competition, SI needs to take care of its workforce and manage its local agencies well. SI has no choice but to deliver superior HR management.

Snelling International's IS Report Card

	D&B	Oracle	PeopleSoft	Ramco	SAP
	HRStream 3.0	Oracle HRMS 1.0	PeopleSoft HRMS 4.0	Marshal 1.0	R/3 2.2
Returned requirements matrix	A	F	A	F	F
C/S payroll ready	Q4-95	Jul-95	A	C	Dec-95
Complex garnishments	F	F	A	F	F
Financials	B	C	B	B	B
HR	B	B	A	B	N/A
Language/toolset	A	B	A	B	C
Depth of database access	A	A	C	C	C
Tax	N/A	A	A	A	N/A
Industry penetration	D	B	A	F	D
References	B	B	A	A	B
Willing to fully demo products (including beta)	D	A	A	B	D
Quality of interaction w/vendor	B	A	A	D	F
GPA	2.6	2.7	3.8	2.2	1.3

WEEKLY GRIND

That just wasn't going to happen with the legacy system, as is or upgraded. Back in 1989, when SI's temp operation was much smaller, the company bought a NetWare LAN-based accounting system from Platinum Software. Then it built a payroll system for it with PC Magic, a 4GL modified to incorporate Platinum's data structure. Everything worked in character mode or paper forms.

By 1994, the system was taking a week to grind out each week's payroll for an average of 6,500 workers. The programmers complained that Magic's architecture rivaled mainframe systems for rigidity. The system lacked an automatic interface between payroll and financials. The system couldn't consolidate automatically across business units. There was no provision for decision support. And payroll was so customized that SI couldn't keep up with Platinum updates. Nor did they see Platinum For SQL (Platinum's own upgrade product), as a possible solution. Platinum didn't offer payroll, and as it was refocusing on its core financials, the future was unclear for Platinum's HR package, too.

In late 1993, Bob Snelling Jr., senior VP of IS, and Buck Buchanan, VP of IS, teamed up to start looking for a better way. They wanted to know who had integrated HR/payroll/financials. They got an initial list of over 100 such vendors from the American Payroll Association. They got to work on the phone calling the vendors, perused HR trade magazines, checked out HR trade shows, and worked up an RFP.

Snelling says 60 of those vendors said they thought they had a product that fit SI's needs, but he and Buchanan quickly found themselves dealing seriously with only a handful of vendors. And "as we kept boring in on them, giving them more requirements, more stopped calling us or told us to go with others," says Snelling. At the behest of top management, Snelling and Buchanan had confined their search to employment agency

verticals and were trying to find something that ran on the AS/400 or NetWare LAN they already had. These products were much cheaper than mainstream client/server products.

Snelling and Buchanan both believed the company needed a modern client/ server package, but company executives weren't so sure, and they were used to making decisions and handing them off to IS to implement. Snelling needed to move IS out of the hired hands category before the company wound up with a system that wasn't actually new and wouldn't carry SI into the future properly.

The change was so huge that Snelling knew a simple decree wouldn't work-even coming from a senior VP and son of the chairman. "I could have gone out by myself as senior VP of IS and made the decision," he says. "But I knew there would be tough times during conversion and installation. Then people would say, 'He doesn't know what he's doing' or 'He's getting kickbacks.' So we had to include everyone. That way, when the tough times come, they have to say 'Yes, this is tough. But there's no way around it.'"

So Snelling did a Texas two-step. First, he included everyone from the chairman of the board to the staff accountants in payroll in each vendor evaluation. Second, he brought in a reputable consulting organization, CSC--not for specific product recommendations, but for strategic direction. "We had CSC educate upper management on the way technology was heading," says Snelling. CSC convinced them that SI had to go client/server and to reject any HRMS products that weren't. This was what Snelling and Buchanan had already told them for free, but it was money well spent.

"My most difficult challenge with IS," Snelling says, "was to politely get the executives to understand that they didn't know what was best for the company in automation" and that IS did know. CSC helped Snelling accomplish both of these delicate tasks. It also addressed the issue of reautomating SI's headquarters in general. SI had multiple databases of information about franchises. If a franchise address changed, it required multiple manual updates. The need to update payroll and financials and acquire HR software had to be seen in this perspective, not as a set of disconnected issues. "We needed a consulting company to help save us from making multimillion-dollar mistakes," Snelling concludes. CTRL-ALT-DEL

After seeing eight vertical vendor demos and hearing out CSC, Snelling and Buchanan--and everyone else--whittled the list down to, well, zero. Just as Snelling and Buchanan had predicted, none of these products would do. They offered little more than payroll and couldn't handle the complexity and scale of SI's operations.

So they started over, this time looking for mainstream client/server HR products. They went back to the initial list of 100 and to the mainstream computer press, especially for information about new products, like Ramco's Marshal Human Resource Management.

All in all, SI talked to 29 companies on the second pass. Lots of vendors backed out fast because of the complexity and scale of SI's needs or because their suites of client/server

tools were incomplete. SI's requirements list had grown to over 247 line items, covering systems, security, data, check processing, payroll processing, taxes, error adjustments, reporting, human resources, accounts receivable, and workers' compensation. Other specific HR requirements included insurance; EEOC; new-hire tracking; tracking I-9s, W-4s, and W-5s; tracking vacations and holidays; benefits; training skills/experience; job/work experience; and resume information.

SI needed to be able to track training, both for job skills and government-mandated safety training. And to compete for the best temps, SI needed to be able to offer benefits, which the HR system had to monitor and manage.

The requirements list was intimidating enough. But the flaming hoop Snelling and Buchanan devised for the contenders came from the depths of payroll: garnishment management.

Garnishments have been a nightmare for SI. A lot of temps have multiple garnishments from multiple counties—or even states—for everything from child support to loan repayments. Multiple legal judgments sometimes mandate dollar amounts that, taken together, exceed the temp's pay. If that happens, the software has to figure out how much goes to whom based on percentages determined in court judgments and limits as to how little you can leave an employee with.

Rules vary from state to state, and you have to figure in reciprocity laws between the states when more than one is involved. A temp may live in one state and work in a second; the SI office may be in the first state, the second state, or even a third. To make things even worse, some temps try to beat the system by having extra withholding taken out to artificially depress their pay. The software needs to spot that and deduct garnishments before the extra withholdings.

Snelling and Buchanan gave the vendors real-life garnishment scenarios to compute, involving multiple job assignments and figuring which and how much would come out for child support, home appliance payments, utility bills, Texas state taxes, and more.

Buchanan says that a lot of vendors just didn't take these complexities into account when they designed their software. When confronted with SI's garnishment deductions test, several vendors said that the scenarios were ridiculous. Buchanan retorted that not only could he show them numerous real examples but SI's own homebrew package could handle them. And SI laid a trap for unsuspecting vendors. Remember those Texas state taxes that had to be figured in? Well, Texas doesn't have state taxes. "We were sneaky about it," Snelling laughs. He adds that most of the vendors made up a tax amount anyway, so the trap worked.

About 18 vendors took the garnishment test: 10 vertical packages and eight client/server. All of the vertical packages failed miserably, others came closer, but not close enough. "A lot of software packages just didn't work right" on garnishments, Buchanan says, adding

that Oracle's chief of research and development decided to revise Oracle's approach to the problem based on the results of the test. Computer Associates said its CA-HRISMA software could handle it, but failed to provide anything like the right amounts in several tries. In some cases, the software prompted for the amounts, then ignored them. Only PeopleSoft HRMS got the right answers and was able to handle interstate reciprocity laws.

What's so Client/Server about HRMS?

ULTIMATELY, NO CONTEST

Buchanan says that PeopleSoft HRMS outshone its competitors elsewhere, as well. "I don't think any of the other vendors' packages were quite comparable," says Buchanan. "PeopleSoft had all the pieces and more effective tracking." The SI team loved all of the tables that came with it. In fact, according to Snelling, "the winner in everyone's mind from early on was PeopleSoft. The comments after every review of the product went "Boy, if we won the lottery, it would be great to have-but so expensive."

The serious finalists to emerge from SI's gauntlet were D&B HR Stream 3.0, Oracle's Oracle HRMS 1.0, PeopleSoft HRMS 4.0, Ramco's Marshal 1.0, and SAP R/3 2.2. And it turned out they were all in PeopleSoft's price bracket. After some soul-searching, the executive team decided to expand the buying budget. Funds also had to be allocated for upgraded hardware and the customization needed to adapt a broadband package to SI's specific needs. The most important change involved a standard procedure for a temp help agency: After SI pays a temp, it has to invoice the client, then pay the franchi--see after deducting SI's royalty and other moneys owed from each franchise's individual agreement. The verticals did all that, of course. So it meant that Snelling and Buchanan needed to look at each vendor's customization capabilities closely.

PeopleSoft uses a proprietary toolset called PeopleTools along with COBOL and C. Oracle and SAP use proprietary 4GLs. Ramco uses VC++, a 3GL. Buchanan compared PeopleTools to PowerBuilder (D&B's tool), and found it not as complete. But COBOL batch-processing support made up for that by not forcing everything to go through a screen interface. Buchanan's biggest worry about using the 4GLs in general was that they would make it easy for someone to go in and mess things up.

SI also seriously considered the treatment it had received from the vendors. Some vendors put their cards on the table, while others treated SI's team like mushrooms; they showed off glossy color brochures that implied products in development were actually complete. Some were more interested in dishing dirt on the competition than in showing off their own stuff.

Snelling did note that PeopleSoft's one-SQL-call-fits-all approach precluded the stored procedures and triggers needed for optimum performance. But he was resigned to having his staff code those in order to get PeopleSoft's other advantages. He also accepted the

need to support it with fast hardware, figuring those costs into his calculations. Ultimately, he could accept slower performance when it was coupled to superior functionality and friendliness.

TELLING INSIGHT

Reference checking and site visits were telling. "The first time we visited a PeopleSoft site, we thought we had somebody who maybe got paid under the table," Snelling said. "But every single site we talked to raved about the product and its implementation. They said yes, it's pricey, but worth it. The Oracle, SAP, and D&B sites said they liked it, it worked well. But they weren't raving."

If SI chose Oracle or Ramco, Snelling knew he'd be working as a beta site and to some extent as a codeveloper. He didn't want to chance it with Ramco, which was new to this country, but he did get close to doing that with Oracle, since SI had opted for Oracle's database. SI ultimately decided not to become a beta guinea pig.

Snelling even had the brass to call SI's 25 chief competitors and ask them what they used. Surprisingly, "18 were quite open with me," he says. Three of them had already bought PeopleSoft, and Snelling feels this would give them all clout with PeopleSoft on issues common to their industry.

The financials weren't ready by the time SI signed the contract in late December, but Snelling was confident that they'd be ready by the time SI was ready to install them. The fact that PeopleSoft had always been aboveboard about where it was on each piece helped build that confidence. However, Snelling would have bought PeopleSoft's HR/payroll package and someone else's financials if need be.

Ordinarily, "a corporate headquarters with 140 employees is never in 100% agreement on anything," says Snelling. "When it comes to software, there are people who staunchly defend their favorites. But from the chairman who'll never have to use this software to IS programmers and system analysts to payroll tax department executives to managers and staff-it was a unanimous decision.

DEFENSE SCIENCE BOARD MILITARY PERSONNEL AND PAY SYSTEM TASK FORCE COMMERCIAL OFF THE SHELF (COTS) FEATURE COMPARISON CHARTS

These Feature Comparison Charts provide you a guide to look at competitive commercial off the shelf products (COTS) in your selection process. As you look at the competitive products Chart #1, you see that Product A provides you all of the features needed for Distributed Client/Server applications at 25% less cost. Chart #2 contains the summary advantages of your selection. Although these Feature Comparison Charts are provided as examples only, they contain the principal features required for an integrated single military pay and personnel system.

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Feature Comparison Chart #1

Feature	A	B
Global Issues:		
Compiled code support	No	X
16 and 32-bit application creation		X
Full object-oriented support:		
- Class Libraries	X	X
- Encapsulation	No	X
- Function Overloading	X	X
- Multi-level inheritance	Limited	X
- Polymorphic Messaging	No	X
Platforms	Windows 3.1, NT, OSF/Motif, Macintosh, character mode.	Windows 95, Windows 3.x, NT, DEC Alpha NT, Mac, UNIX (Sun Solaris)
Functional Capabilities:		
Application Partitioning		X
C++ Class Builder	Limited: Can call DLLs, but cannot support the language	X
Class Library (Pre-built objects, sample framework & services via the Foundation Class library)	No	X
Central design repository for defining and storing extended attributes	X	X
Configuration Management	No	X
Database engine (included)	X	32-bit Sybase SQL Anywhere
Database stored procedure and trigger support	via database supported products	X
Database interoperability & scalability to Sybase SQL Server for full enterprise deployment	No	X
Database support	Oracle RDBMS (native access) and ODBC- only connectivity to non-Oracle databases	Native Access to: Oracle, Sybase SQL Server, BM DRDA, Informix SE, Informix Online, MDI Gateway for DB/2, Microsoft SQL Server, and ODBC connectivity to Btrieve, IBM DB2, DB2 for AS/400, dBase II III IV V, Excel, Netware SQL, Paradox, Text, Sybase SQL Anywhere
Data pipeline for data conversion & migration between databases	No	X
DDE	X	X
DLL support	Limited: can call, but not create.	X
Debugger (built-in)	X	X
Foundation Class Library (reusable, pre-built objects and services to accelerate development)	No	X
Help-online	X	X
Integrated Mail support (MAPI)	Via integration w/3rd party only	X
Library for Lotus Notes	Via integration w/3rd party only	X
Object browser (including OCXs)	No	X
Object management	X	X
ODBC version 2	X	X
OLE 2.0 custom control (OCX) Support	X	X
OLE 2.0 extended support		
- Plug & Play with any OCX	No	X
- OLE automation - OLE automation servers	No	X
- OLE server-enabled DataWindow	No	X
- Point & click SQL interface to OLE	X	X
Point-and-Click Technology that eliminates SQL coding	No	X

Feature Comparison Chart #1		
Feature	A	B
Risks:		X
(e.g. vendor bankruptcy, obsolete product)	Products favor a closed architecture that discourages customers who want to employ an open systems approach.	None
Pricing	\$3,995	\$2,995
Feature Comparison Chart #2		
The Summary Advantage		
Requirement/Feature	A	B
Fast Applications		
Compiled Code	X	
Native Drivers	X	
Distributed Objects		
OO with Inheritance	X	
Partitioning	X	Stored Procedures Only
Data Anywhere		
DataWindow	X	
Full ODBC Support	X	X
Applications Anywhere		
Multi-Platform	X	X
Multi-Platform Controls	X	

**Ms. Padalino's memo with SYBASE input
to the Defense Science Board Task Force on
Military Personnel Information Management
Report BAFO, (8/7/96)**

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7-Aug-1996

OUSD(PNR) R&R-IM
Attn: Norma St. Clair
4015 Wilson Blvd.
Suite 1212
Arlington, Va. 22203

Subject: Criteria for selecting COTS software for DoD-wide Personnel and Payroll

Dear Ms. St. Clair:

Sybase is pleased to have the opportunity to provide this input on criteria for selecting a COTS application for the DoD's Personnel and Payroll requirements. Although Sybase does not directly produce software for Personnel and Payroll, our open database management, middleware, and application development tools provide the technology foundation for many of the industry's leading COTS application vendors. The criteria these COTS applications vendors used in selecting Sybase products as their foundation technology was driven by their customer's needs. It is that criteria described herein and also the criteria that will best help the DoD in selecting a COTS Personnel and Payroll application with the lowest life-cycle cost and shortest implementation time.

Criterion 1 - Open Database: The COTS application should run "natively" with multiple SQL RDBMSs, including either the big four-- e.g., Sybase, Informix, Oracle, Microsoft-- or, at a minimum, the two specified in the Defense Information Infrastructure (DII) Common Operating Environment (COE) published by DISA-- e.g., Sybase and Oracle. This means that the application can directly run on a choice of RDBMSs without any performance loss or redundant data storage requirement. COTS applications that require a proprietary vendor file system or specific RDBMS to natively store data and then redundantly copy data to other RDBMSs do not meet the Open Database criterion. Selecting a COTS Personnel and Payroll application should in no way force you to select or standardize on a single database.

Open Database support would benefit the DoD primarily through cost savings in two key areas: 1.) those accrued from competition in acquisition organizations need to purchase a new RDBMS to run the COTS application and 2.) those associated with organizations being able to re-use their existing inventory of NAME and save cm purchase and re-training costs. Secondly, adoption of the Open Database criterion would benefit the DoD through the inherent benefits from the flexibility provided by a choice of SQL RDBMSs-- these included leverage over vendors to provide first rate support or risk swap out, and the ability for the DoD to select the best of breed RDBMS at the time of deploy given that title will continue to change hands quite regularly over the period of deployment.

Criterion 2 - Open Tools: The COTS application should be built upon and modifiable with open application development tools that support rapid application development, facilitate managed re-use, and are widely used in industry as well as the DoD. The Open Tools criterion requires that the COTS application toolset run "natively" with multiple SQL RDBMSs for the same reasons listed above for the Open Database criterion and for the additional reason that non-native interfaces, such as the Open Database Connectivity (ODBC), do not meet the performance requirements of large, complex applications like those of the DoD's Personnel and Payroll would applications.

The additional benefits of the DoD adopting the Open Tools criterion (i.e., over and above the benefits described under the Open Database criterion) are in two areas: 1) training and personnel cost savings and 2) in development time savings. By selecting a COTS application that employs a toolset that is widely used in industry and government, the DoD will find it much less costly to find, train, and acquire personnel resources with sufficient expertise in the required locations. The also speed up its development effort as it wouldn't have to spend time and moneys to train its staff or contractors in the use of vendor-proprietary toolsets. Finally, the DoD would benefit in cost and development time savings from the "rich and robust" third-party market for software development environments and productivity enhancements that are ever-present around industry-standard toolsets.

Sybase realizes that the DoD will need to consider many other criteria (such as functionality fit with DoD's requirements, vendor market share, ease of modification, etc.) in selecting a Personnel and Payroll application. The above described Open Database and Open Tools criteria will ensure the technological underpinnings of the selected Personnel and Payroll application are consistent with DoD's objectives for selecting COTS-- life-cycle cost savings and minimized implementation times.

Should you have questions, do not hesitate to contact me at 301/896-1757. Thank you for giving Sybase this opportunity to participate in this important Defense Science Board action.

Sincerely,

A handwritten signature in black ink, appearing to read 'Peggy Padalino', with a long horizontal line extending to the right.

Peggy Padalino
Account Manager

**Mr. Selsor's memo with GRCI input to the
Defense Science Board Task Force on Military
Personnel Information Management
Report - BAFO, (8/7/96)**

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1900 Gallows Road Vienna, Virginia 22182 (703) 506-5000

August 7, 1996

Chairman, Defense Science Board
c/o Norma J. St. Claire Personnel and Readiness Office of the Under Secretary of Defense
4015 Wilson Blvd., Room 204
Arlington, VA 22003

Reference: input to the Military personnel Information Management Task Force Report

The purpose of this memo is to provide observations regarding EC role of adapting a COTS solution for the MPM21 Objective System and the degree to which that solution may simplify design/development tasks, reduce timelines and save money.

Clearly, there are good analogies in the business community that demonstrate the effective use of COTS solutions for integrated personnel and payroll systems. It would be in the government's best interest to explore several of the most relevant solutions so that a full range of alternatives may be understood and valuable information gained from these industry experiences.

It should be noted, however, that the MPM21 Objective System will need to satisfy a demanding range of requirements, including:

- Integration of active, reserve, and reserve components,
- Ability to scale solutions so that they provide effective functionality to every operational level from detachment to top of the system,
- Ability to accommodate multiple hardware/software suite combinations at every level,
- Ability to integrate across personnel and pay functions as well as share data with other functional area systems (i.e., logistics, medical),
- Ability to accommodate wartime and peacetime operational environments,
- Ability to integrate with legacy systems, and to interoperate and share data with other enterprise systems on the DII.

Determining the ability of COTS products to address all of these requirements is critical to program planning. A gap analysis may show how much functionality comes "out of the box", but equally important is the complexity of functionality not addressed by COTS products. The tailoring and extension of COTS software to meet MPM21 requirements

Chairman, Defense Science Board
August 7, 1996

may test the engineering rule-of-thumb, which is that it takes 90% of the development cycle to achieve the last 10% of critical functionality. Only a full laydown of essential requirements can lead to that determination. As a result, shortening of the timelines due to adapting a COTS-based solution may make it infeasible to provide a system that meets all of the stated requirements.

Additionally, a series of fundamental technical issues must be evaluated before a program timeline and life-cycle cost estimate can be established with reliability. These issues include: the degree of COTS tailoring needed; the amount of new software necessary to meet functionality not addressed by COTS; the complexity of integrating new modules with COTS products; performance trade-offs of running a hybrid COTS/designer software system on all hardware/software suites used by MPM21; and the maintenance to support modified COTS, new software, and integration software products created to support this project.

COTS packages often incorporate industry best practices and provide excellent functionality. Leveraging existing COTS software may shorten the application development portion of the system schedule, however, industry metrics show that less than 20% of project costs are expended developing code, while integration tasks can consume close to 25% (derived from case studies used in Checkpoint project costing software developed by Software Productivity Research, Inc.). Tailoring and integrating COTS-based applications into enterprise environments present unique management and technical issues distinct from traditional development efforts. Based on our experience participating in the development of other large DoD enterprise systems, such as, Joint Computer-Aided Acquisition and Logistics Support (JCALS) System, Reserve Component Automation System (RCAS), and the Defense Investigative Service (DIS), we have confirmed that the integration of COTS can be more complex than fairly well-defined application development segments and as a result, can have a significant impact on the system development schedule.

We agree that COTS solutions should be vigorously pursued for MPM21. By using proven COTS products to satisfy mission requirements, DoD will realize significant benefits by leveraging complete and tested products for its functional modules. Before enterprise-wide deployment, however, it is important to prototype and benchmark these COTS-based solutions. The purpose of this benchmarking effort is threefold. First, it can be used to update the objective system architecture by providing valuable information on the degree to which COTS software meets requirements and by identifying new software modules that are needed to realize full functionality. Second, it can be used to identify the full scope of system integration tasks and validate the COTS-integration process. Third, it will help define a standard method for implementing interfaces to legacy systems, as well as achieving interoperability and data sharing with core DII systems

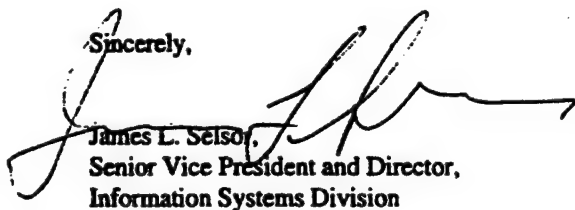
Chairman, Defense Science Board
August 7, 1996

(i.e., GCSS). Accordingly, the initial COTS initiatives should be viewed as interim solutions that can be fully exercised by all services to validate the utility of the product and to help prioritize the addition of greater functionality. Lessons learned from these efforts can be incorporated into the final objective system through an aggressive product improvement program which gives the added benefit of reinforcing user confidence by incrementally proving the value of progressively enhanced system updates.

We understand that an incremental development approach may be more time consuming than originally envisioned. Lessons learned from past and current large-scale development efforts, however, demonstrate to us and our government clients that a progressive development plan offers the highest chance of success in fielding a system that responds to the complex requirements that an MPM21 objective system must address.

Thank you for the opportunity to provide this input. Building a DoD enterprise military personnel system demands the best industry can offer. We realize the magnitude of the challenge faced by the Defense Science Board and DoD in this endeavor and we would be happy to provide further details or respond to questions that might arise from our observations. If we can provide additional information please call Paul Schuessler at 506-5336.

Sincerely,



James L. Selson,
Senior Vice President and Director,
Information Systems Division

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**BG Pellicci's (USA,Ret) memo with ORACLE
input to the Defense Science Board Task Force on
Military Personnel Information Management
Report - BAFO, (8/6/96)**

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ORACLE®

August 6, 1996

Ms. Norma St. Claire
OSD, Personnel & Readiness
4015 Wilson Blvd Ste 1212
Arlington, VA 22203

Dear Norma:

On behalf of Oracle Government, I am pleased to provide our final observations and input concerning the Defense Science Board Task Force on Military Personnel Systems.

Attached is our two(2) page input.

Also, included is the clarification to question 8.

Regards,



Jack Pellicci
Vice President
Oracle Government

JP/rp

enclosure(s)

Recommendations to the Defense Science Board (DSB).

As a leading developer and provider of information technology and services, Oracle would like to take the opportunity to advise the DSB in the area of COTS software. Oracle believes that the following evaluation points are a viable litmus test for any vendor under consideration to fulfill DoD requirements. Although the genesis of this document is the evaluation of COTS HR systems and their applicability to the DoD, the following recommendations are valid for the full spectrum of COTS applications, i.e. financials, payroll, manufacturing, inventory, etc.

The DoD should assess their current investment in information technology for the HR domain. The integration of COTS HR with current development environments in DOD should be maximized in order to reduce cost and overall: time of implementation and leverage existing infrastructure investment.

There should be an acknowledgment of the compelling business case for DOD, the Services and the taxpayer through the use of core COTS HR in conjunction with an open, non-proprietary, portable and widely used development environment (RDBMS & tools). Additionally, this business case should include documentation of the lower life cycle costs of ongoing efforts in "customized" COTS to support continuous improvement in an area of accelerating change and fiscal constraint. This assessment should be measured using the metrics of both dollars and time. With which vendors has the DoD obligated most of their funding? For a responsible vendor, a significant investment translates into a superior level of customer support. In which vendors products are the most developers and contractors trained? An established base of trained personnel keeps the learning curve shorter, allowing more time for productive system development. These factors weigh heavily in the likelihood of success.

The DoD should select scaleable, open systems components for their HR systems. One of these components must be an extensible HR product and a payroll product which can be seamlessly integrated at the DOD or service level, as well as proven implementation methodology and services capability.

One of the keys to achieving success with the DoDs HR customers is the ability to effectively support the entire enterprise; from small workgroups to larger departmental organizations as well as providing agency level visibility. As we have seen, organizations are routinely downsizing and upsizing, commands are merging or dispersing. Scalability needs to be defined as both the ability for the system to seamlessly and rapidly increase in size or scale down based upon customer requirements. A rapid transition from an in-garrison configuration to a contingency operation should be achievable without diminished capability. Additionally, specific hardware, networking, operating systems, etc. should not be a gating factor in the scalability decision. The DoD should select open systems components which afford the agility to move to new technology with price/performance benefits without an onerous transition cost. Most current legacy systems deliver the functionality required at the time they were specified. However,

infusing new technology into these systems is generally difficult and prohibitively expensive. DoD customers demand GUI applications, Web integration and other relatively new technologies from their systems.

The DoD should identify a COTS HR provider who is able and willing to participate in a proactive partnership with DOD and has the corporate size, market experience and staying power to share in the development/integration of core and unique DOD military personnel system components.

The COTS provider must consider the effort as equally important to their business as the DoD. They must have the corporate size, market share and commitment to share in the development effort. The COTS provider must also be able to assist in the migration of DOD and its components to best practices in personnel management/HR across national, industry and intergovernmental boundaries by affiliation with a global partner who provides the experience and customer base to achieve this critical objective.

The DoD should initiate the expeditious development of service functional requirements in a standard repository which allows for easy comparison and rapid determination of common requirements. (extension of JWG process).

The MPM 21 initiative should be used to drive towards the greatest degree of common requirements. The fewer service unique requirements that exist, the less duplicate development efforts will need to take place.

The following are Oracle's perspective on the recommendations.

The DoD should assess their current investment in information technology for the HR domain...

The DoD through their efforts with the Air Force at San Antonio, the Navy at New Orleans has spent millions dollars with Oracle. These procurements have been used to fund software, training and support. As a result, there is an Oracle HR knowledge base in DoD that far exceeds that of any other COTS HR provider. From a core technology perspective, Oracle maintains a 70+% market share of the relational database market within the federal government. This market share ensures that government requirements maintain high visibility within Oracle.

The DoD should select scaleable, open systems components for their HR systems...

Oracle is portable and scaleable to a wide range of hardware environments and architectures. All DoD standard contract hardware and operating system platforms can run Oracle HR. Oracle is still the only vendor that can provide identical core technology from the desktop, through the workgroup server market up to and including enterprise level computing environments. Additionally, Oracle supports over 90 different hardware and operating system combinations as well as a wide variety of networking topologies. The transition from UNIX to NT to Windows is little more than an export and import of data. Oracle's Open Gateways and APIs provide an environment which over 3,500

vendors have used to develop products which integrate/interoperate with the Oracle product set. Oracle's Open Gateway technology allow for the transparent integration of non-Oracle data including; Sybase, Informix, DB2, VSAM, APPC, etc.

Oracle maintains an enviable list of industry firsts from the first commercially available SQL RDBMS to, most recently, web integration- This track record provides the DoD) with a high confidence level that new technology will be integrated with the product, ensuring a leading edge end product for their HR customers.

The DoD should identify a COTS HR provider who is able and willing to participate in a proactive partnership with DOD...

Oracle has invested, and will continue to invest, millions of dollars in an effort to integrate government requirements into the core Oracle HR product. Through continual training, workshops, proofs of concept and briefings, Oracle, in a relatively short period of time, has demonstrated a tangible effort at partnership and joint accountability for the success of the COTS HR initiatives.

The DoD should initiate the expeditious development of service functional requirements in a standard repository which allows for easy comparison and rapid determination of common requirements. (extension of JWG process).

Oracle agrees with this initiative. Oracle plans to integrate DoD common requirements into the Oracle HR product. It is incumbent upon the DoD to agree to the maximum amount of commonality, thus insuring a greater level of COTS product capability.

**Mr. Larry Rinderknecht memo with EDS
input to the Defense Science Board Task Force
on Military Personnel Information Management
Report - BAFO, (8/20/96)**

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August 20, 1996

Defense Science Board Task Force Chairman and Executive: Secretary, Dr. Salisbury and Ms Norma St. Claire

From: EDS Military Systems

In July's meeting of the Defense Science Board (DSB) Task Force on Military Personnel, Dr. Salisbury offered the opportunity for everyone present to provide "Brief and Final Observations" on the recommendations to be made by the DSB Task Force.

EDS has been following the DSB deliberations since February when we made a presentation to the Board. As a large information systems integrator, we are and have been involved in many integration efforts similar to that being considered by the DSB. Of these, the one that is most comparable to the DoD in terms of scope and complexity is our integration work for General Motors (GM) in all functional areas including human resources and payroll. Those efforts began in 1984 and are continuing today.

Based on our GM experience, and that with other clients around the globe, we offer comments on three Terms of Reference (TOR) of the DSB.

TOR 1: A single, fully integrated DoD personnel/payroll objective system for 2001 (MPM 21).

We strongly recommend adoption of the **objective of having a fully, integrated DoD personnel and payroll system** by early in the 2000 decade.

When EDS was acquired by GM, and assumed responsibility for all of GM's IT personnel and assets, EDS was assigned the mission of supporting GM's production of world-class quality vehicles, while containing what had been ever increasing IT costs.

Accomplishing this mission in GM presented special challenges. The size of the bureaucracy, the fragmentation of efforts across different divisions, the outdated IT infrastructure of many organizations, the lack of technical talent possessing significant functional experience and the cost were factors that mitigated against an immediate integration solution. While many of GM's systems are fully integrated, others are not.

However in GM integrated systems always remained the objective, simply because of the payoff in large **resource savings and enhanced productivity**. Normally, the GM/EDS team worked first to establish "best practice" business processes and then to upgrade and fully interface GM's systems and infrastructure before tackling an integration solution. Payroll is a notable example as full integration is commencing just now.

Over the years we have found that **managing expectations was the singular most difficult task since integration is not easily, quickly or inexpensively achieved.**

We applaud the emerging DSB position of calling for a **common core as the right first step** to integrating the DoD's HR and payroll systems. Identification of a common core should begin with an in-depth process analysis which should result in identification of a common core of sufficient size to enable implementation of an integration solution in the time frame mentioned.

TOR 2: A COTS-based solution to generate savings.

We believe a COTS-based solution is capable of generating savings for DoD, **provided careful limitations on scope of customizations are imposed.**

Our experience in working with many excellent COTS providers is that there simply is **no single COTS package that will totally fit** any corporate or government set of requirements. In the case of the DoD, this is particularly true if you include the unique characteristics of military manpower and tour assignments as part of the personnel function/system. Hence, the reality for a DoD system is that some customization must occur. The issue is how much? Customization of COTS applications cost money. If the customization is really extensive, it can make acceptance of subsequent upgrades of the COTS product prohibitively expensive.

To be worthwhile, and minimize cost, most purveyors of COTS solutions would tell you that a COTS package must meet two conditions in order to make a COTS solution a viable option for the organization to pursue:

- 1) As a generalized **rule of thumb, the package must have an inherent "fit/gap" of at least 80/20 % to the current business processes, or**
- 2) **the "owners" of the business processes must be willing to tailor their processes to fit the COTS package.**

It should be recognized that customization is essentially a software "tailoring" effort that is an iterative process involving close work between vendor and customer. Even when done right, it is not a speedy process and may take months or even years to complete particularly if you include upgrades.

It is also worthy of note, that issues of ownership and maintenance of the "tailored" software quickly arise and need to be openly discussed and resolved up front. Finally, the ability of any COTS packages to handle high volume processing is a major issue that we faced in GM and should be evaluated for a very large customer like DoD.

TOR 3: A "generally sound" personnel community strategy that will rely on "Executive Agents" to implement the objective system for 2001.

We believe that **use of service "Executive Agents" as change agents** to implement an objective DoD Personnel/Payroll system **can be a sound strategy** provided necessary management controls are in place to ensure continuous integration throughout the systems development/implementation period.

Our experience in GM was that any process of IT integration/development required an "empowered" change agent (one having authority, responsibility **and financial control**). All lesser degrees of managerial control/coordination yielded deficient results. Ultimately the EDS/GM team adopted a new IT systems approval process to ensure continuous integration and continuous revalidation of business need throughout the development process. This process is still in use today.

We appreciate that operational and service needs may dictate a less centralized management solution within DoD. These can work, but will require much tighter integration of the interfaces between respective systems developed under the auspices of different "Executive Agents" or else, as GM chose, the assignment of such integration responsibilities to a third party. Our experience is that the requisite level of integration has to be much greater than the mere specification of standards or declaration of a generalized common operating environment.

EDS actively supports the efforts of the DSB Task Force and stands ready to assist the DoD and the Services as they move forward to defining and implementing the objective Military Personnel System 2001.

EDS appreciates the opportunity to share these thoughts with members of the Board. If we can provide any additional information, please call Deane Stanley or Larry Rinderknecht at (703) 742-1679 or 742-1651.

Respectfully submitted

*Military Systems Division
13600 EDS Drive
Herndon, Virginia 22701*

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APPENDIX B: TASK FORCE PARTICIPANTS

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Participants of the Defense Science Board Task Force on Military Personnel Information Management

<u>DSB Task Force Members</u>	<u>Organization</u>
Dr. Alan B. Salisbury - Chair	President Learning Tree International
Admiral Stanley Arthur (USN, Ret)	Vice President, Naval Systems Lockheed Martin Corporation
Mr. Tony Battista	ARB Consultant
LTG Tom Carney (USA, Ret)	Deputy Librarian of Congress
Dr. David Chu	Director, Washington Research Department Rand Corporation
Dr. Carl Dahlman	Associate Director Forces & Readiness Policy Center NDRI Rand Corporation
Dr. Larry Druffel	President & Director South Carolina Research Authority
Mr. Pete Janak	VP & CIO TRW
Mr. Christopher Jehn	Senior Vice President ICF Kaiser International, Inc.
LtGen Robert Ludwig (USAF, Ret)	Information Technology and Management Consultant
LtGen Anthony Lukeman (USMC, Ret)	Executive Director Marine Corps Association
BG James R. Ralph (USA, Ret)	Executive Vice President ARS, Limited
Dr. William Wulf	Interim President National Academy of Engineering

Participants of the Defense Science Board Task Force on Military Personnel Information Management (cont'd)

<u>DoD Advisors to the Task Force</u>	<u>Organization</u>
Mr. Frank Rush	PDASD(FMP), OUSD(P&R)
Mr. Al Bemis	DASD(M), OASD(RA)
Mr. Anthony Valletta	DASD(Acquisition), OASD(C3I)
RADM Ronne Froman	Director J-1, Joint Staff
MG Fred Vollrath	ADCSPER
RADM Lee Gunn	DCNP
Ms. Debbie Howell	Deputy Assistant COS, M&RA
Ms. Sandra Grese	HQ USAF/DPC
Ms. Angie Bruce	Senior MAISRC Management Analyst, OUSD(C)
<u>Executive Secretaries</u>	<u>Organization</u>
Ms. Jeanne Fites	DUSD(R&R), OUSD(P&R)
Ms. Cynthia Rand	PD(IM), OASD(C3I)
<u>Staff Support</u>	<u>Organization</u>
Ms. Norma St. Claire	Director, IM, OUSD(P&R)
Ms. Scarlett Curry	OASD(C3I)
Mr. Kevin Cassidy	OUSD(P&R), IM
Ms. Cynthia Hansen	OUSD(P&R), IM
Mr. John Ello	DSB Executive Director, OUSD(A&T)
LTC T. Van Horn	DSB, OUSD(A&T)

APPENDIX C: TERMS OF REFERENCE

This USD (A&T) memorandum dated February 23, 1996 and addressed to the Chairman of the Defense Science Board defines the Terms of Reference for the Task Force on Military Personnel Information Management.

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ACQUISITION AND
TECHNOLOGY

THE UNDER SECRETARY OF DEFENSE
3010 DEFENSE PENTAGON
WASHINGTON, D.C. 20301-3010



Feb 23, 1996

MEMORANDUM FOR CHAIRMAN, DEFENSE SCIENCE BOARD

SUBJECT: Terms of Reference - Defense Science Board Task Force on Military Personnel
Information Management

You are requested to form a Defense Science Board (DSB) Task Force to advise the Secretary of Defense on the best automation strategy to support the military personnel and pay functions for all active and reserve components throughout the Department.

The Military Personnel Information Management Task Force will provide advice, recommendations, and supporting rationale which address the items below.

- Assess the Department's military personnel information management requirements and determine the most desirable, feasible, and cost-effective automation solution: for instance, one integrated active/reserve military personnel/pay system or multiple interoperable systems sharing a common data base.
- Assess the cost-effectiveness of adopting and reengineering one of the Service's existing systems as the standard rather than initiating new development that may take advantage of more modern technologies, including Commercial Off The Shelf (COTS) applications.
- Evaluate the strategy being pursued by the military personnel community (OSD and the Services) which includes defining detailed requirements for data, interfaces, and functional processes for joint military personnel information management and designating the Navy and Air Force, respectively, as Executive Agents for the design and development of field and database level applications which would support core requirements.
- Assess the strategy for dealing with Service specific systems while joint military personnel information management core requirements are in development.
- Determine how to ensure that current military personnel operations are not interrupted or compromised in any way that would interfere with DoD's ability to mobilize or provide appropriate support to military personnel and veterans.

The Under Secretary of Defense (Personnel and Readiness) and the Assistant Secretary of Defense (Command, Control, Communications, and Intelligence) will jointly sponsor and provide funding for the Military Personnel Information Management Task Force, Mr. Alan Salisbury will serve as Chairman of the Task Force. Ms. Jeanne Fites and Ms. Cynthia

Rand will serve as the co-Executive Secretaries. LTC T. Van Horn will be the Defense Science Board Secretariat representative. The Office of the Under Secretary of Defense (Acquisition & Technology) will provide funding to support the activities of the DSB members on the Task Force.

The Military Personnel Information Management Task Force will meet at least monthly and will receive initial briefings and background data on:

- the roles and responsibilities for the Defense Information Management Program;
- the analyses and findings of the Military Personnel Information Management efforts;
- descriptions and assessments of each of the Services' active and reserve military and pay systems, to include both functional and technical information;
- a description of the military personnel migration strategy and efforts to define requirements for a single, integrated, military personnel information management and pay system.

We request that you provide a report August 31, 1996.

This Task Force will be operated in accordance with the provisions of P.L. 92-463, the "Federal Advisory Committee Act," and DoD Directive 5104.5, the "DoD Federal Advisory Committee Management Program." It is not anticipated that this Task Force will need to go into any "particular matters" within the meaning of Section 208 of Title 18, U.S. Code, nor will it cause any member to be placed in the position of acting as a procurement official.



Paul G. Kaminski

APPENDIX D: RECOMMENDATIONS MAPPED TO TERMS OF REFERENCE TASKS

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Appendix D

Recommendations Mapped to Terms of Reference Tasks

A brief summary of recommendations mapped to the specific questions in the Terms of Reference is provided below. (This summary is intended only for the purpose of supporting the mapping of the questions stated in the Terms of Reference to the recommendations and discussion in the main body of the report; it is not intended that this appendix substitute for the actual recommendations in the report.)

1 - Assess the Department's military personnel information management requirements and determine the most desirable, feasible, and cost-effective automation solution: for instance, one integrated active/reserve military personnel/pay system or multiple interoperable systems sharing a common data base.

The Task Force strongly recommends (Recommendation A, Section IV) that the Department move to a single, fully integrated, personnel and pay system with common core software based on a modified-COTS solution. This objective system should incorporate standard data, meet all DoD technical Common Operating Environment guidelines, and include Service specific modules as required to ensure maximum support. Sections III and IV of the report provide additional details on the objective system, a recommended path, and an organizational structure to achieve an Initial Operating Capability by or before 2001.

2 - Assess the cost-effectiveness of adopting and reengineering one of the Service's existing systems as the standard rather than initiating new development that may take advantage of more modern technologies, including Commercial Off The Shelf (COTS) applications.

Although the Task Force members did not have the time to perform an in-depth cost analysis, a clear consensus was reached that DoD should adopt a COTS-based solution rather than reengineering one of the existing systems. While the objective system is expected to generate savings associated with the functional processes, the primary functional benefits will come from enhanced performance and support to Service members.

Recommendation B, Section IV, details the recommended COTS strategy. In addition, considerable discussion of functional and technical issues related to COTS is provided in Section III (para A.4., para A.5., and para B.1). Costs and potential savings are addressed in Section II (para B.).

There should be significant savings associated with the development and maintenance of a common system, although some up front investment is required

and savings are in the outyears. Maintenance savings should accrue because in the future there will be a need to maintain and update a single system instead of many. Even greater savings will be realized when future modernizations are required, since all future modernizations would be from a common base. Technical experts pointed out that even if functional requirements change during the development process there are great technical and cost advantages associated with creating the common baseline for all future modifications. Information provided to the Task Force from the United Kingdom Personnel Administration Agency suggested potential cost savings of up to thirty per cent on the maintenance of a harmonized personnel and pay delivery system. Similarly, the experiences of the Marine Corps and the Air Force in consolidating and integrating their systems demonstrate expected savings. Additionally, the Navy Functional Economic Analysis for the Navy Standard Integrated Personnel System also projected savings associated with consolidation and integration.

3 - Evaluate the strategy being pursued by the military personnel community (OSD and the Services) which includes defining detailed requirements for data, interfaces, and functional processes for joint military personnel information management and designating the Navy and Air Force, respectively, as Executive Agents for the design and development of field and database level applications which would support core requirements.

Recommendation B, Section IV, addresses this issue. Basically, the Task Force believes that the general strategy of the personnel community is sound, but must be accelerated to meet a timeline that has relevance for the Department. System functional requirements must be defined in a joint environment, with full participation from the Services, the Joint Staff, and OSD. The USN and USAF agreed that they would accept the roles of Executive Agents for the objective system. The Marine Corps representatives in the Joint Requirements and Integration Office/Joint Working Group should play the lead role in defining the functional requirements for effective integration of personnel and pay.

4 - Assess the strategy for dealing with Service specific systems while joint military personnel information management core requirements are in development.

Recommendation C, Section IV, directly addresses the transition strategy.

The fielding of SIDPERS-3 should continue as planned within the Army. The Navy accepted the challenge to focus on the objective system, integrating the development of deployment of critical NSIPS and NMPDB capabilities into the objective system program, and agreed to continue as Executive Agent for the field system. The Air Force agreed to the role of Executive Agent for the corporate tier and system architecture. Ongoing and planned Air Force and USMC

modernization efforts will also be refocused on the objective system. In short, all planned new modernization efforts should be refocused on the objective system.

5 - Determine how to ensure that current military personnel operations are not interrupted or compromised in any way that would interfere with DoD's ability to mobilize or provide appropriate support to military personnel and veterans.

This is also addressed in Recommendation C, Section IV.

The Task Force reviewed with each of the Services their thoughts on individual transition strategies. Detailed transition plans should be prepared by each Service by September 30, 1997. Consistent with the roles and strategies indicated in items 2, 3, and 4 above, individual transition plans for the Services should allow for continuity of support until the objective system is available.

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